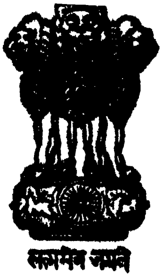

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THE LAPSTONE CREEK EXCAVATION: TWO CULTURE PERIODS REVEALED IN EASTERN NEW SOUTH WALES.

By FREDERICK D. MCCARTHY, Dip.Anthr. (Syd.).
(Australian Museum.)

(Figures 1–131.)
(Figures 95-131 are contained in Plates I-IV.)

This paper is an account of the results of the excavation of a rock-shelter situated (Figure 1) on the southern side of a gully a few hundred yards north of the bridge over which the Great Western Road crosses the Western Railway Line. This gully is on the eastern slope of the Blue Mountains, and the rock-shelter, which faces northward, is at its lower end. Lapstone Creek flows down the gully to the river half a mile to the east. From various vantage points above the rock-shelter the aborigines had a wide view of the lowlands towards the river. Before the railway was constructed there was easy access from this gully to the Nepean River and Emu Plains. Nowadays a high railway embankment runs across the gully and shuts off completely the old way of access.

The deposit was first noticed by a local resident, Mr. G. E. Bunyan, who found some flakes just below the surface in 1936. Soon afterwards, unfortunately, the whole of the occupational deposit at the western end of the rock-shelter was dug out by several private collectors, whose main interest was the acquisition of specimens, and they made no records of their work or of the specimens recovered. A small trench was dug by them at the eastern end, but otherwise the deposit excavated by us was undisturbed. Mr. Bunyan kindly invited a party to excavate the latter portion of the deposit, and in December, 1936, the task was undertaken by the late Mr. C. C. Towle and Messrs. G. Bunyan, C. Towle, Sr., G. A. Williams and the author. The late C. C. Towle and the author wrote a preliminary account of the work, most of which is included in the present report; to it I have added sections ii to vi.

This rock-shelter is one of a type which occurs commonly in the Hawkesbury Sandstone formation in the central coastal district of New South Wales. It is a deep rock-shelter (Figure 95) in which perfect protection is given in wet and cold weather. It measures 10 metres across the entrance, 3 metres from the front to the back wall in the middle, and 1·4 metres from the undisturbed floor to the ceiling which is smoke-blackened as a result of long occupation.

Prior to the occupation of the rock-shelter by the aborigines, some very large blocks of sandstone had fallen from the outer edge of the roof, and these, together with other rocks, formed a somewhat irregular platform across the entrance (Figures 97–98). This platform was approximately 8 metres in length, and its surface was 1·4 metres above the rock-floor of the cave. Some of the blocks on the outer side of the platform sloped steeply towards the bottom of the gully.

On their arrival at the site, the aborigines apparently found the rock-floor comparatively free of débris. The platform of rocks formed a natural barrier across the entrance and confined the hearth deposit, which, as it accumulated, spread to the limits of the cave. Eventually the deposit increased to such a height that it spread out over the rocky platform, and before we commenced our excavation only the tops of three of the larger blocks of sandstone were visible.

Within the cave conditions were favourable to the steady and undisturbed growth of the midden, and the work carried out by us revealed a homogeneous deposit 1·4

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metres deep. At the extreme eastern end, owing to the slope of the rock-floor, the deposit was only 0·85 metre in depth, and this was the shallowest section excavated.

In the early stages of occupation the steeply sloping rock-floor must have made the cave a very uncomfortable place of abode for the aborigines because it has a general angle of about 45 degrees. The deposit rested entirely on the rock-floor, and its deepest part was behind the rocky platform around a central fire-place (Figure 98). The natives slept on a layer of grass (Hunter, 1793, p. 59) or rushes (Officers' Journal, 1789, p. 17).

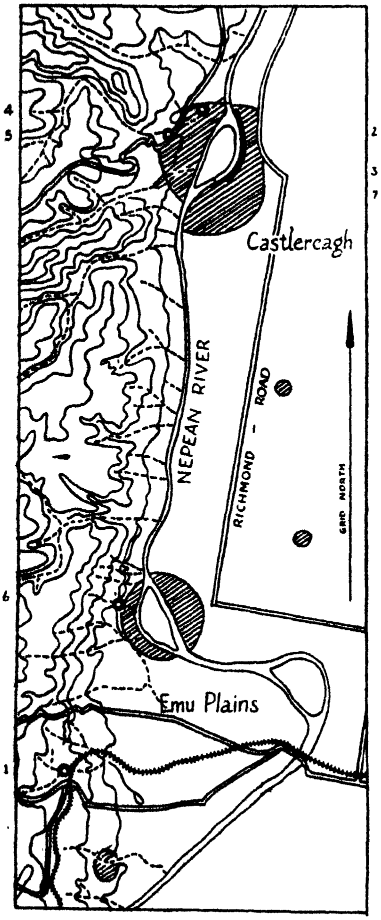


Figure 1.

Map of the Emu Plains and Castlereagh area showing the dissected escarpment of the Blue Mountains, and the Nepean River flowing through the plains. The creeks are shown as dotted lines. The river bank is fifty feet high, and west of the river the first contour line is the 100 ft., and the balance are the 200 ft. series to the top of the range. The positions of the sites dealt with in this paper are as follows: 1. Rock-shelter on Lapstone Creek just north of the junction of the railway line and road. 2. The shaded areas represent the various surface workshops. 3. The narrow black strip beside the river at the northern end of the map is the site of the axe-grooves and engraving of a kangaroo (Fig. 94). 4. Rock engraving of a kangaroo (Fig. 93). 5. Rock engraving of kangaroo hunt (Fig. 92) beside Hawkesbury Lookout Road. 6. Rock-shelter, in a creek bed, containing human hand stencils (Fig. 100). 7. Black's Falls, site of supposed fish-trap, shown by line across river at the southern end of the axe-grinding site. Scale 1 inch = 1 mile or 1·60 kilom.

We are unable to state with any certainty when the aborigines ceased to occupy the cave. The first farms along the Nepean River were established in 1794 and the aborigines were thinned out rapidly during the hostilities between them and the settlers during the subsequent ten years. There were natives in the Emu Plains district until about sixty years ago, but most of them were from west of the Mountains and elsewhere.

There is, at present, no satisfactory method of estimating the length of time during which the deposit was accumulating, but this matter will be referred to again. Palaeontological evidence is entirely lacking, and the only remains of fauna comprise a few small pieces of animal bone, practically unidentifiable, and two snail shells.

Method. We excavated (Figures 96–98) the whole of the deposit at the eastern end of the rock-shelter. Our excavation, as measured along the edge of the rocky platform, was 5·8 metres long, up to 3 metres wide, and from 0·85 to 1·4 metres deep. It is regretted that a test-strip was not left for future workers, but this course was decided against because we considered that any portion of the deposit left untouched by us would be ransacked as was the western end. Furthermore, the excavation of other rock-shelters in the gullies along this scarp will provide a suitable substitute for such a test-strip.

The work was commenced by digging a trench (Figure 2) from the front to the back of the rock-shelter at a distance of 3·71 metres from the eastern end. A layer of fine dust, up to 9 cm. thick, which had accumulated since the aboriginal occupation, was taken off the surface. Thin layers of the deposit were then put through a very fine sieve, and each of the six layers A to F (Figure 3) was dealt with before the next one was commenced. The deposit excavated was taken out in seven sections; the results were compared and found to be uniform from top to bottom throughout the deposit. The many thousands of unused stone flakes and the large number of implements recovered were well distributed throughout the deposit, no part of which was devoid of them. Careful watch was kept for evidence of stratification or for any slight changes which may have taken place during the occupation, but there was no perceptible change visible to us in the compact, dark-coloured ash-laden midden. Apparently, therefore, the rock-shelter was in regular if not continuous occupation, although the implements in the deposit indicate very clearly that a somewhat abrupt cultural change took place at one period, about the middle, in its history.

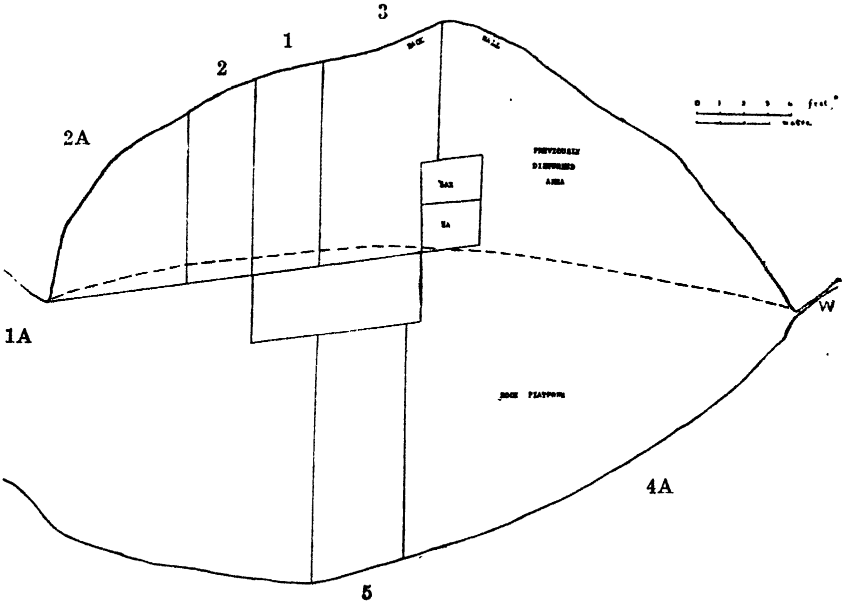


Figure 2.
Horizontal plan of the Lapstone Creek rock-shelter. The numbers represent the sections excavated, and the dotted line represents the margin of the rocky platform.

Reference has already been made to the rocky platform (Figures 97–98) outside the rock-shelter, but its unusual character merits detailed description. It was, in all, 8 metres long. The first 3 metres at the eastern end consisted of large blocks of sandstone, the next 2·3 metres was composed of smaller lumps, and the remaining section at the western end consisted also of large blocks. In the middle section the large blocks receded for almost 1 metre and the whole space was filled up by the smaller lumps of sandstone placed there by the aborigines. When this section was excavated it was found to consist of small blocks of sandstone of a handy size, averaging about 45 x 30 x 15 cm., around which ash was tightly packed. These blocks had been piled up by the aborigines to make the fire-place from time to time as the deposit increased in depth, and this niche was thus used continuously as the hearth. At a height of 60 cm. from the rock-floor, the aborigines added several more of these blocks in such a way that they formed a level platform about 1 metre wide, on top of which a larger flat-sided slab was propped on its side (Figure 97) with a smaller stone to support it possibly as a backing to the fire-place. A considerable quantity of ash was taken out of this niche and it contained implements from top to bottom. The *Bondi* points were met with in it at a depth of 90 cm. and were then found down to the rock-floor.

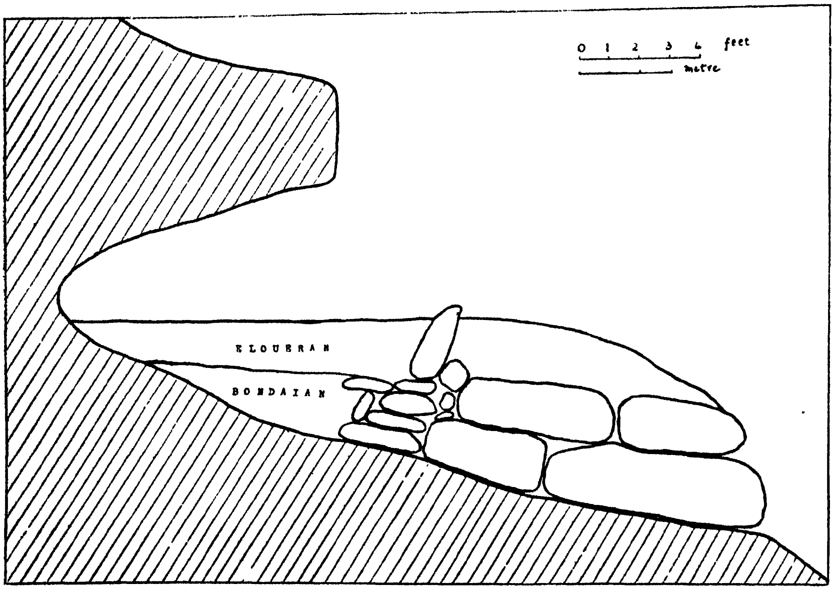


Figure 3.
Vertical section of the deposit from the outside edge of the rocky platform to the back wall of the rock-shelter. It shows the group of small blocks of sandstone in the fireplace, the large slab set on its edge on top of the latter, and the large blocks outside.

We have given close attention to the inner side of the rocky platform because in the middle of it the aborigines built the above-mentioned more or less regular wall. This may not have any great significance because they may simply have pushed back as far as they could any rocks projecting into the rock-shelter or lying on its floor. If, however, they had any deliberate intention of constructing a regular wall it is difficult to give any reason why it was done.

II. DESCRIPTION OF IMPLEMENTS.

To simplify the description and understanding of the implements, and in view of the fact that they consist so definitely of two industries, they are dealt with accordingly. The Bondaian industry consists of layers A to C, and the Eloueran industry of layers D to F. There is a slight marginal overlap between the two industries, as excavated.

Bondaian Industry.

COROID IMPLEMENTS.

NUCLEI.

(*a*) *One Platform* (Figures 4–7).—Among the 49 cortex-backed nuclei 30 possess a plain and flat, 13 a plain and dished, 5 a faceted, and 1 a dished and faceted striking-platform. Eighteen of these have a pointed, 6 a flat, 25 a cortex-rounded (among which some have a straight edge), and 2 a chisel end. One of the latter two is a perfect example of the type (Fig. 6) from layer A, with a dished and faceted platform and narrow flake-scars. None bear battering or splintering on their distal end. In shape they are all flat or convex-faced elongate pieces, not very thick, knapped on the front and lateral margins, and their cortex back is frequently flat. One is quartz. Most of the flake-scars are narrow. Five are from 2 to 3 cm. long, the remainder up to 5 cm.

Among the 12 prismatic nuclei knapped all around, 4 have a plain and flat, 2 a dished and plain, 3 a flat and faceted, and 3 a dished and faceted striking-platform. Six have a chisel or keeled, 2 a pointed, and 4 a rounded cortex end. Most of the flake-scars are narrow. Three to 5·5 cm. long.

There are 12 secondary nuclei in the above two groups. Most of them bear one, sometimes two, narrow flake-scars on a lateral margin. Some of them are impossible to distinguish from burins, particularly where the flake-scars are truncated, and in fact might well have been used for burinate purposes. On the other hand, they probably represent failures in striking the points. Van Riet Lowe (1946, 242, fig. 2) has also drawn attention to this difficulty in connection with bi-polar fracture and stated that the possibility of these implements having been used as burins cannot obviously be ruled out. The secondary nuclei are from 3 to 3·5 cm. long.

The angles of the striking-platform and knapping face are as follow: 60 to 65°—2; 66 to 70°—0; 71 to 75°—12; 76 to 80°—9; 81 to 85°—9; 86 to 90°—4.

(*b*) *Two platforms at opposite ends* (Figures 8–12).—Among the 42 cortex-backed nuclei 22 bear 2 plain and flat, 1 two plain and dished, 9 one plain and one dished, 2 two flat and faceted, and 8 one plain and one faceted striking-platforms. Seven have one chisel or keeled end, and on 32 the two platforms are either at a right or a steep angle. It is impossible to make any distinction between chisel-ended and flat-based platforms because a few have the two platforms at right angles, some have one at a right angle and one at a steep angle, and some have both at a steep angle. Where the two platforms are at a steep angle the two knapping faces meet at an angle in the middle of one side of the nucleus, but on the other kinds the knapping face is usually vertical or nearly so. Most of these nuclei are thin and there are only a few thick irregular pieces among them.

Among the 35 prismatic nuclei knapped all round, 13 have two plain and flat, 3 one flat and one dished plain, 5 two plain and dished, 3 two faceted, 7 one plain and one faceted, 6 two faceted and dished striking-platforms. Fifteen have a chisel or keeled end, and 26 from flat to angled ends.

There are 25 nuclei from 2 to 3 cm. long, and 40 up to 5 cm., and one 7 cm.

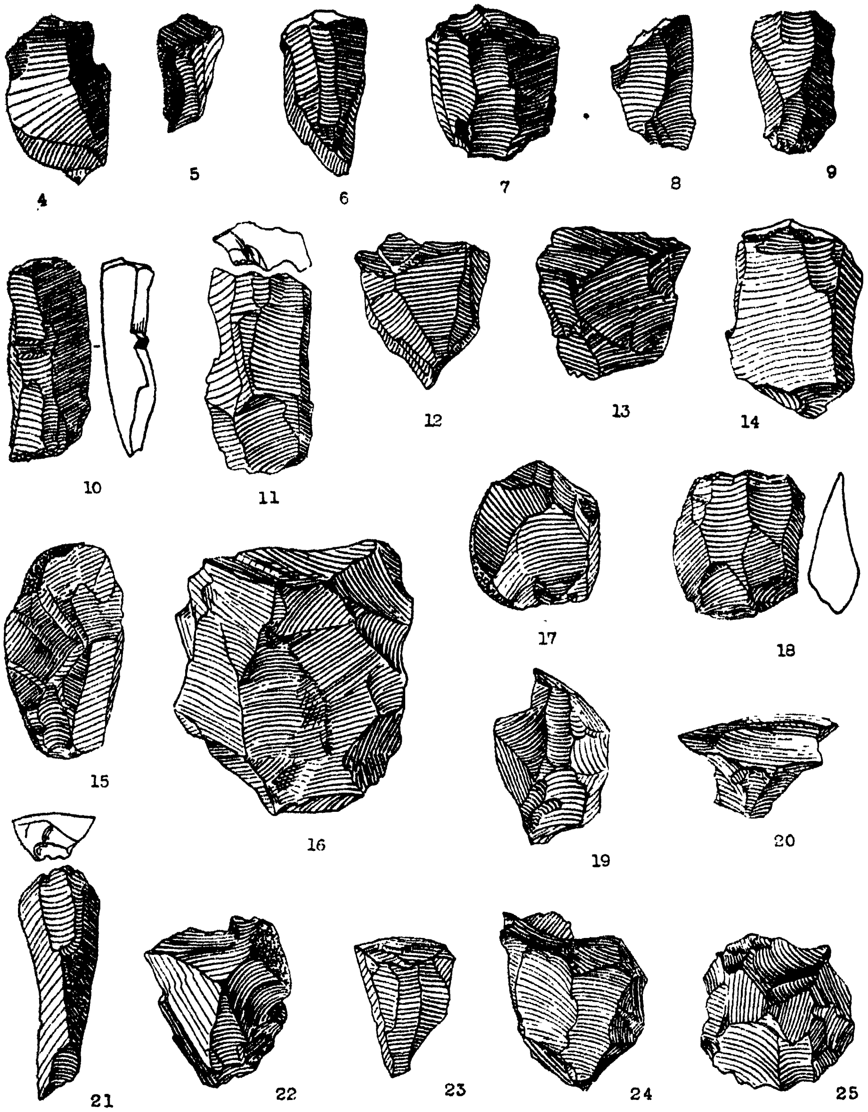
There are 16 secondary nuclei in the above two groups.

Several of these nuclei bear a concave working edge 1·25 cm. wide and 2 mm. deep on one lateral margin. One of the quartz nuclei displays bi-polar working.

The angles of the striking-platform and knapping face are as follow: 60 to 65°—2; 66 to 70°—0; 71 to 75°—16; 76 to 80°—13; 81 to 85°—10; 86 to 90°—9.

(*c*) *Two platforms at right angles* (Figure 13).—The 9 specimens are all irregular in shape, with all but several of the platforms plain and flat, the other being dished. One is 2·5, and the remainder from 3 to 5 cm. long. The angles are similar in range to the nuclei with one and two striking-platforms.

(*d*) *Alternate platforms.*—No examples.



Figures 4-25. Nuclei.

Bondaian industry.—4. Cortex back, one platform. 5. Cortex back, with plain and dished platform. 6. Cortex back, with faceted and dished platform, chisel-ended. 7. One faceted platform, keeled end. 8. Cortex back, with one plain and one faceted platforms. 9. With one plain and one faceted platforms. 10. Cortex back, with one plain and one faceted platforms. 11. Two dished and faceted platforms. 12. One dished platform and keeled end used as platform. 13. Two platforms at right angles.

Eloueran industry.—14. Cortex back, one faceted platform. 15. Cortex-backed quartz pebble. 16. Cortex back, one dished platform. 17. Cortex back, one plain platform. 18. One plain platform and keeled end. 19. One faceted platform. 20. Conical microlithic nucleus with dished platform. 21. One faceted platform. 22. Two plain and flat platforms. 23. One plain and flat platform. 24. Two plain platforms at right angles. 25. Discoid nucleus with alternate platforms.

The full range of nuclei is shown in this series in which the shapes and angles of the platforms are indicated.

Re-directing flakes.—The eighteen examples found comprise 11 thin pointed pieces from 3·5 to 6 cm. long, 3 blade-like pieces from 5 to 6 cm. long, and 4 thick blocks from 3 to 4 cm. long. All bear the characteristic truncated flake-scars.

KNAPPED IMPLEMENTS.

Blocks (Figure 26).—Four specimens, all 4 cm. long. One has three concaves 7 mm., 1 cm., and 1·5 cm. wide, and up to 4 mm. deep, on a lateral margin, one has one concave 1·5 cm. wide and 2 mm. deep, one is a convex end scraper, and one is a side and end trimmed scraper with a concave 3 cm. wide and 5 mm. deep on one lateral margin. The remaining specimen, 4·5 cm. long, has a shallow end concave 2·5 cm. wide.

Slices.—There are two examples from layer B. One (Figure 59) is a split-pebble slice 13 × 9 × 2·5 cm. in size, roughly trimmed along the thick outer crescentic margin and gapped by use along the chord. The other one is a side-blow slice, 12·5 × 10 × 2·5 cm., with a semi-discoidal and roughly trimmed thin edge and thick outer margin.

NORMAL FLAKES AND BLADES.

Elouera adze-flake (Figures 27–28).—Only five specimens were found in this industry. One of type i is trimmed on the inner edge of the thick margin, and its saw-trimmed chord bears a slight use-polish. It is 3·5 cm. long. Two are of type iii, both perfect examples, 4·5 and 5 cm. long, trimmed on both edges of the thick margin, and one of them has a shallow concave 1·5 cm. wide on the chord.

Scrapers (Figures 30–33, 35–37).—The side scrapers comprise 14 narrow to broad blades from 3·2 to 5 cm. long. Several are asymmetrical and cortex-backed. One is a broad side-blow flake 3·2 cm. long, and there are two side-blow blades, one of which is trimmed on the edge of the inner face. Another blade is trimmed on the inner face also. Only one has a faceted butt.

Among the double side scrapers is a blade (Figure 29) 8 cm. long, heavily trimmed on one lateral margin from keel to edge, and use-polished on the other lateral margin. There is also a blade 3'5 cm. long, 1·5 cm. wide, and 7 mm. thick, trimmed on the inner face of one margin and heavily use-polished on the other margin. The other two specimens are reverse-trimmed blades 3·3 and 3·5 cm. long.

The only side and end scraper is a narrow keeled blade 4 cm. long with a steep-faced end.

The end scrapers comprise a small series of blades, either keeled or flat, and some are very thin pieces. Two of them have a steep-faced working-edge. The latter on most examples is straight, and is oblique on three. Two of them have a faceted butt and one is a butt-end scraper. They are from 3·2 to 4 cm. long.

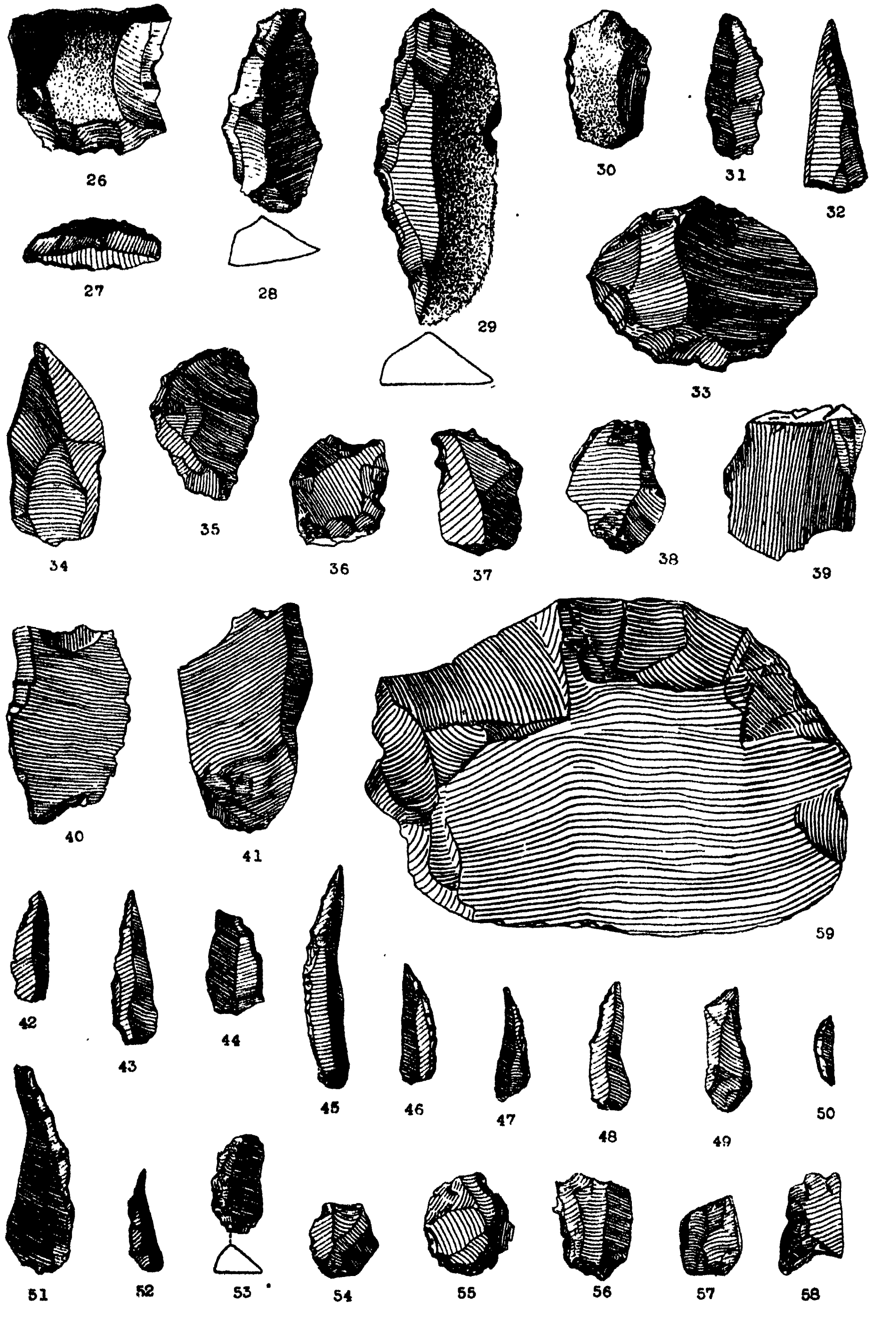
There is a fine example of a semi-discoidal scraper on a thick flake 6 cm. long. with several shallow concaves and a broad rounded nose on the working-edge.

The concave scrapers are well represented, being a mixture of flakes and blades on which 3 have the concave on the lateral margin, 3 on one end, and one on the butt. One has two reverse concaves on one end. Two of these specimens have a faceted butt. The concaves are from 1 to 1·5 cm. wide, one being 2 cm., and from 2 to 5 mm. deep. They are usually on a trimmed margin, and on a thick portion of the edge. One is a side-blow flake. They are from 3·25 to 5 cm. long.

Four blades bear a nose, three being on a corner of the distal end, and one on the lateral margin. One is like a parrot-beak in shape. The noses are rounded and small.

Knives and saws (Figure 34).—These are all narrow to broad blades, four of which have a faceted butt. Twenty of them bear a knife edge with primary scaling, and 3 have a bi-scaled saw-like edge. One has a cortex back, and several are pointed. They are from 3·5 to 7 cm. long.

Burins (Figures 39–41).—Those with a plain platform are a relatively poor series of 7 specimens, and only two of them might be regarded as utilized. Two are on side-



Figures 26-29. Bondaian industry.

26. Block, with lateral and end concaves. 27-28. *Elouera* adze-flakes of type iii, scraper use on chord. 29. Blade with heavy step-chipping on one margin and use-polish along the other margin. 30. Side scraper. 31. Side scraper, with use-polished edge on one margin. 32. End scraper. 33. Semi-discoidal scraper. 34. Knife used on both lateral margins. 35. Blade with scraper edge on one margin and saw-edge on other margin. 36. Scraper with concaves on lateral margin and end. 37. Double-end scraper, with small concave on butt, nose on distal

blow flakes. The working edge is formed by one spall on six and by two spalls on one, and it is from 5 to 8 mm. wide. One has been re-struck. They are from 3·5 to 5·8 cm. long.

The scaled series comprises one rostrate and 8 concave platforms. The working-edge is formed by one spall on 8 and by three spalls on one, and is from 4 mm. to 1 cm. wide. One (Fig. 40) which has been re-struck displays a truncated spall-scar and is a perfect example of the scaled burin. One is a double with a plain platform at the other end. Parts of their margins bear scraper trimming or knife use. They are 3·5 to 5 cm. long.

On the majority of the above burins the working edge is formed at the distal end of the blade or flake.

Bondi Points (Figures 42–52).—These were well represented in each of the three layers, and on analysis gave the following result:

1. Partly trimmed on inner edge:

A. Point end and plain butt	46
B. Point end and butt	13
C. Point end and faceted butt	14

Two in the B variety have an oblique and a straight butt end respectively and are thus of Woakwine-point type. Among the faceted-butt kind two are thick, broad and oblique ended, and one is short and broad like an asymmetrical trapeze.

2. Fully trimmed on inner edge:

D. Plain butt	26
E. Rounded trimmed butt	40
F. Faceted butt	16

The smallest point in the collection, 1·8 cm. long and 4 mm. wide, is in this group and is a beautifully made example of E. Two of the largest points, both broken at the distal end, are in this group. Several possess the high triangular form of trimmed butt. Two of the E variety are of *Woakwine*-type, and another one is a very thick point 4 × 1·5 × 1·5 cm. in size.

3. Trimmed on both edges of thick margin:	G. Partly	13
	H. Fully	19

In the G variety 6 have a plain, 5 a trimmed, and 2 a faceted butt, and in the H variety 17 have a trimmed and 2 a faceted butt. One is a large flat point 6 cm. long and 2 cm. wide. One is trimmed half-way along the chord as well as on the thick margin.

4. Use on chord. Eight show primary knife use, one has a bi-scaled saw-like edge, and 4 bear scraper trimming. Three examples are trimmed on both margins at the point end, possibly for use as piercers.

5. Dimensions: 1–2 cm., 5; 2–3 cm., 120; 3–4 cm., 48; 4–5 cm., 9; 5–6 cm., 4.

There are 120 out of a total of 182 specimens in the 2–3 cm. group, which is dominant on all other sites in New South Wales analysed to date (McCarthy, 1943; McCarthy & Davidson, 1943).

Six of the points were found between 71 and 76 cm. deep in layer D, due no doubt to the contour of the surface of the deposit. I therefore place them in layer C.

Flake fabricators (Figure 38).—Few bipolar flake and blade fabricators were found. It is possible, therefore, that they were not used in fashioning the *Bondi*-points as I

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end, and several other small concaves on margins. 38. Bipolar flake-fabricator of punch-type, used at each end. 39. Scaled burin, with three transverse spalls, possibly of fluted type. 40. Scaled burin, showing re-struck spalls. 41. Scaled burin. 42-46. *Bondi* points trimmed on one edge. 47-48. *Bondi* points trimmed on one edge and of *Woakwine* variety. 49. Oblique trimmed blade. 50-52. *Bondi* points trimmed on two edges of thick margin. 53-58. *Microliths.* 53. *Elouera* adze-flakes of quartz, type iii. 54-56. End scrapers. 57. Bipolar flake fabricator, punch-type, used at both ends. 58. Concave end scraper. 59. Large slice trimmed on one end and chord.

have previously suggested (McCarthy, 1943, p. 130). The four specimens recovered are from layer C. Two are crescentic blades 4 and 5 cm. long, heavily worked on both lateral margins, one is a narrow keeled blade, 4 cm. long, used at one end and use-polished on one lateral margin, and the other one is a blade, 3·5 cm. long, used at both ends.

Unused flakes.—Among the unused flakes and blades are 28 with a faceted butt. Most of them are narrow blades but some are of the slender point type.

PERCUSSION STONES.

These comprise five oval pebble hammerstones, from 5·5 to 10 cm. long, used lightly on parts of their margins and one on one surface in addition. One is made of quartz.

MICROLITHS.

Blocks.—Two have a concave 1 and 1·5 cm. wide and 3 mm. deep, and two have convex working edges. One of the latter is a thick semi-discoidal scraper. They are from 2·5 to 3 cm. long.

Elouera adze-flake (Figure 53).—The only example is of quartz, 2·7 cm. long, of type iii, and its outer face is cortex.

Scrapers.—The side scrapers comprise three flakes and two blades, one of the latter has a use-polished edge on a very thin margin, one is steep-faced, and one is trimmed on the inner face. There is one double side scraper on a thick flake. They are from 1·8 to 3 cm. long.

The end scrapers (Figs. 54–56) consist of 4 thumbnails with a trimmed semi-discoidal margin, whilst the trimmed end is convex on 3, straight on 2, and steep-faced on 1. They are mostly short blades, three of which are keeled, and one has a faceted butt. They are from 1·8 to 2·95 cm. long. There are also two oblique trimmed blades 3 cm. long.

There are two discoids, 2 and 2·5 cm. in diameter, from layer C, and one of them is reverse-trimmed.

The concave (Fig. 58) and nosed kinds are well represented, as in the larger normal flake and blade scrapers. They are mostly short blades and irregular flakes 2·5 to 3 cm. long. Four possess a concave from 1 to 1·5 cm. wide and up to 3 mm. deep, one has two similar concaves, and one has a concave 1 cm. wide and 2 mm. deep on the end and a scraper edge on the other margin. One is a side and end scraper with a small nose and concave on the end, and another one has a rounded nose between two concaves 7 mm. wide and 2 mm. deep. They are from 2·3 to 2·8 cm. long.

Knives.—There are six blades from 2 to 3 cm. long bearing primary knife use, and one has a bi-scaled saw-like edge. One has a faceted butt. Five are narrow blades and one a broad one.

Burins.—One 2·8 cm. long, with plain platform, has a transverse working edge 4 mm. wide and a faceted butt. The scaled series comprises one with a concave and one with a convex platform, with one and two opposing spalls respectively forming working edges 5 and 8 mm. wide. One is a double with a concave scaled and a plain platform, both with one opposing spall and working edges 4 mm. wide. They are 2·8 and 3 cm. long.

Segment.—One example (Figure 80), 3·3 cm. long, is steeply trimmed right along the inner edge of the outer margin, and lightly bi-scaled on the chord as though used for cutting.

Flake Fabricators (Figure 57).—These comprise one used on one lateral margin and six punch-type used at both ends. Five of the latter are quartz bi-polar struck blades. They are from 2 to 3 cm. long.

Composition of the Bondaian Industry.

It will be seen from the above description and the table that the Bondaian point is the outstanding specialized implement in the Bondi industry at this site, being abundant throughout layers A to C. The *Elouera* adze-flakes and the flake-fabricators are scarce in these layers. Nuclei with one striking-platform, or two at opposite ends, are predominant. They are either cortex-backed or knapped all round, have a pointed, rounded cortex, chisel or flat base, and a flat, dished, plain or faceted striking-platform. Right-angled platforms are uncommon, whilst alternate and compound platforms are unrepresented. Blocks are scarce, whilst slices and long blades are absent. The side, concave and nosed scrapers are the commonest kinds; knives and burins are well represented. Among the microliths the side, end, concave and nosed scrapers are the commonest varieties; *Elouera* adze-flakes, flake-fabricators and burins are rare.

The *Bondi* points were met with at a depth of from 71 to 76 cm. in the greater part of the deposit, and in one part at 91 cm. From the wall of rocks in the front to the back wall of the rock-shelter the Bondaian industry was almost a level deposit and from west to east it varied only a few inches. The points were the most important implement of the natives who first occupied the rock-shelter, and remained so for an appreciable, but at present immeasurable, length of time.

TYPES.	BONDAIAN INDUSTRY.				ELOUERAN INDUSTRY.				OUT-SIDE.
	A.	B.	C.	Totals.	D.	E.	F.	Totals.	
Nuclei:				I. Coroid Implements.					
One striking platform	9	19	33	61	24	11	3	38	8
Two striking platforms—									
At opposite ends	9	22	46	77	24	12	2	38	5
At right angles	2	1	6	9	3	5	1	9	1
Alternate platforms	—	—	—	—	5	1	3	9	—
Indiscriminate platforms	—	—	—	—	1	15	3	19	9
Re-directing flakes	3	7	8	18	5	1	1	7	—
				II. Knapped Implements.					
Blocks	—	2	2	4	6	—	—	6	—
Slices	—	2	—	2	2	1	—	3	1
Worimi cleaver	—	—	—	—	1	—	—	1	—
Long blades	—	—	—	—	1	—	—	1	—
Normal flakes and blades—									
Elouera adze-flake	1	1	3	5	30	5	4	39	4
Scrapers—									
Side	2	5	7	14	16	10	7	33	4
Side and end	—	1	—	1	—	—	—	—	2
Double side	—	—	4	4	6	—	—	6	—
End	4	1	1	6	2	—	—	2	—
Semi-discoidal	—	—	1	1	—	—	—	—	—
Concave and nosed	4	4	5	13	14	2	2	20	1
Knives and saws	1	10	2	23	12	10	1	23	—
Use-polished edges	—	—	—	4	—	—	—	8	2
Piercers	—	—	—	—	1	—	—	1	—
Burins—									
Plain platform	1	4	2	7	1	—	1	2	1
Scaled platform	1	2	6	9	1	—	1	2	—
Flake fabricators—									
General	—	—	2	2	2	3	3	8	1
Punch-type	—	—	2	2	6	4	3	13	—
Bondi points	42	58	86	186	—	—	—	—	2
Microliths—									
Blocks	—	2	2	4	—	—	—	—	—
Elouera adze-flake	—	1	—	1	10	9	15	34	11
Scrapers—									
Side	—	6	—	6	10	14	15	39	11
Side and end	—	—	—	—	2	2	—	4	—
Double side	—	—	—	—	—	2	1	3	1
End	1	4	5	10	—	1	1	2	3
Discoidal	—	—	2	2	—	—	—	—	—
Concave and nosed	1	7	3	11	4	6	6	16	—
Knives and saws	—	4	1	5	2	6	3	11	3
Piercers	—	—	—	—	—	—	1	1	—

	A.	B.	C.	Totals.	D.	E.	F.	Totals.	
		II. KNAPPED IMPLEMENTS—*Continued.*							
Burins—									
Plain platform	—	—	—	—	—	—	1	1	—
Scaled platform	—	1	2	3	1	—	1	2	—
Flake fabricators—									
General	—	1	—	1	1	6	10	17	—
Punch-type	2	2	2	6	8	35	24	67	—
Geometrical—									
Segment	—	1	—	1	—	—	—	—	—
Oblique trimmed blade	1	—	1	2	—	—	—	—	—
Bi-marginal point	—	—	—	—	—	—	1	1	—
			III. EDGE-GROUND IMPLEMENTS.						
Axe-heads—									
Windang type	—	—	—	—	1	—	—	1	1
Pebble type	—	—	—	—	4	1	—	5	2
Biface coroid	—	—	—	—	1	—	—	1	—
***Bulga*-knives**	—	—	—	—	1	3	—	4	—
Biface pebble axe-blanks	—	—	—	—	—	1	—	1	—
				IV. PERCUSSION STONES.					
Hammerstones	1	2	2	5	2	2	—	4	1
				V. MISCELLANEOUS.					
Pieces of red ochre	—	—	—	—	2	2	—	4	1

Eloueran Industry.

COROID IMPLEMENTS.

Nuclei.

(*a*) *One striking platform* (Figures 14–21).—Among the 28 cortex-backed nuclei 20 possess plain and flat, 2 plain and dished, 3 a dished and faceted, and 3 a cortex striking-platform. Fifteen of these have a pointed, 6 a rounded cortex, 4 a chisel or keeled, and 2 a flat distal end. On two the latter end is splintered and battered as though they had been knapped on an anvil-stone. Most of these nuclei are comparatively broad and flat, but not very thick, whilst some are long and narrow. They display both convergent and vertical flake-scars.

Among the 10 prismatic nuclei knapped all round 9 have a plain and flat, and one a plain and dished, striking platform. Six have a pointed and 4 a chisel or keeled end. Two of these are conical nuclei only 2·5 cm. high, one with prominent spurs around its margin, whilst its platform is dished on one side by the removal of a re-directing flake.

One is a jasper pebble with a rounded end, and a reverse-worked striking platform at the other end with angles of 90°.

There are two quartz nuclei of prismatic form, 2 and 3·5 cm. long, One chert nucleus has two deep and truncated flake-scars across its striking-platform at right angles to the knapping edge to form a dished platform. One is a secondary nucleus 3 cm. long.

There is one triangular nucleus 3 cm. long with a flat striking platform and its distal end is splintered as though from an anvil during knapping.

The nuclei with one platform range from 2 to 5 cm. long, one being 7·9 cm.; 20 are 3 cm. and under and thus of microlithic size.

The angles of the striking-platform and knapping face are as follow: 61 to 65°—3; 66 to 70°—2; 71 to 75°—3; 76 to 80°—8; 81 to 85°—3; 86 to 90°—7.

(*b*) *Two platforms at opposite ends* (Figures 22–23).—There are 26 cortex-backed nuclei, of which one has one and one has two dished and faceted, 8 have flat cortex, and the balance have plain and flat striking platforms. Two have a chisel, and the others a flat distal end.

Among the 12 prismatic nuclei knapped all round there are 6 with a dished, 2 with a dished and faceted, and the balance with plain and flat striking platforms. Two of these are chisel-ended, and the others are flat-based.

The flat and dished platforms occur in various combinations of two dished, a flat and a dished, or two flat together. In regard to the flat-based variety the same remarks apply to the nuclei in this industry as in the Bondi industry, the actual angles varying from 90° to 80° and lower. One small nucleus has a concave working edge at one end. One prismatic example, 4 cm. long, has a heavily step-chipped gouge-shaped distal end due to use. There are two nuclei with knapping faces only 3 cm. high, two cortex platforms at 80°, and cortex back. One flat-sided nucleus has two platforms on one lateral margin at an angle of 80°. There are four elongate quartz nuclei 4–5 cm. long with a rough cortex platform at each end, and three narrow prismatic quartz nuclei 2·5–3 cm. long evidently knapped by the bi-polar method.

There are 17 nuclei between 2 and 3 cm. long, and the balance are up to 5 cm.

The angles of the striking-platform and knapping face are as follow: 61 to 65°—1; 66 to 70°—1; 71 to 75°—3; 76 to 80°—4; 81 to 85°—9; 86 to 90°—3.

(*c*) *Two platforms at right angles* (Figure 24).—Most of these nuclei have a concave flake-scar as the second platform, which is thus a dished one. A narrow flake-scar runs from one lateral margin across the striking-platform of one secondary nucleus. The largest nucleus is a roughly prismatic cortex-backed example 6·5 x 5 x 3 cm. in size, with a cortex platform on its longest margin at an angle of 86° to the knapping face, and a dished platform at right-angles to the cortex platform; the distal end is splintered and crushed as though from use on an anvil during knapping. Two are 2·5 and 3 cm., the others from 4·5 to 6·5 cm. long.

(*d*) *Alternate platforms* (Figure 25).—This method of knapping is represented on a small number of nuclei, as is usual in New South Wales industries. Most of the specimens are roughly worked in poor material. Two elongate pebbles, 4·5 and 7·5 cm. long, have been developed from single-platform nuclei into the alternate type. Five examples, all 4 cm. long, are oval biface discoids, and one of them is a thickish piece. The flake-scars are mostly short and broad but some are long and very narrow.

(*e*) *Indiscriminate platforms.*—There are many quartz nuclei of this kind in layers D to F, and they range from pieces 2 cm. long to pebbles 5 cm. long, with one 10 cm.

Re-Directing Flakes.—The seven specimens found range from slender edge-blades (which are sometimes mistaken for points or abrupt-trimmed blades) up to 4 cm. long to blocks from 4 to 6 cm. long.

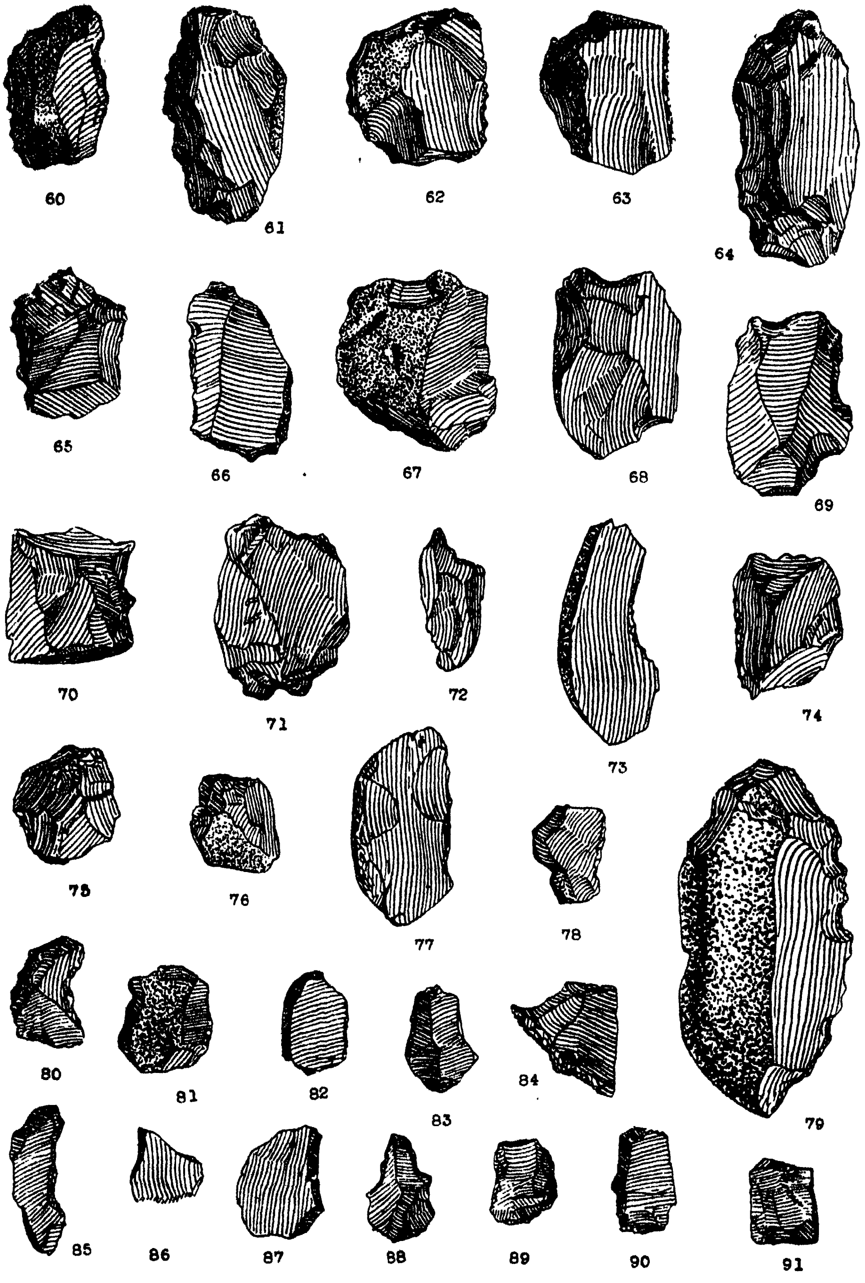
KNAPPED IMPLEMENTS.

Blocks.—In this industry, consisting of small implements, the blocks are few in number. One, 5 cm. long, is a side-blow flake with a trimmed convex end, and one, 3·5 cm. long, has a shallow concave at each end.

Slices.—These, too, are few in number. Two are side-blow flakes 12 x 11 cm. x 4 cm. and 11 x 8 x 3 cm. in size, with convex edges used for cutting purposes. One is a split-pebble slice 12 x 7 x 1·8 cm. in size with flaking on the margin of the cortex face.

Worimi cleaver (Fig. 110).—A fine example was recovered from layer D, and it is the only specimen from the site. It is 20 x 6 x 6 cm. in size and 2 lb. 6 oz. in weight, with the point of percussion at the junction of the three surfaces at one end, that is, on the corner of the chord. The outer face is of cortex, the inner face a flat cleavage surface, the inner edge of the thick back is crudely trimmed along the lateral and convex end margins, both of which also bear evidence of percussive use. The straight chord is use-polished in the middle, particularly on the inner face, and the edge is slightly rounded or blunted as a result. It is made of a grey hornfels and resembles very closely examples from workshops on the north coast of New South Wales (McCarthy, 1941, p. 24, Pl. vi, fig. 11, and 1947).

Long Blade (Figure 79).—A unique chert blade from layer D is worth special mention. It is 8·8 cm. long, has a median ridge or keel from end to end of its outer surface, and a cortex striking-platform. It is trimmed along one lateral margin, on which there are five concaves from 7 mm. to 1·25 cm. wide and up to 4 mm. deep, and



Figures 60-91. Elouera Industry.

60. *Elouera* adze-flake of type i, scraper use on chord. 61. *Elouera* of type ii, use-polished on chord. 62. Broad *Elouera* of type iii. 63. *Elouera* of type i, use-polished right along straight chord. 64. *Elouera* of type iii, use-polished right along convex chord. 65. Lateral concave scraper. 66. Double-side scraper. 67. End scraper. 68. End concave scraper. 69. Lateral concave scraper. 70. Scraper with concaves and nose on lateral margin. 71. Scraper with two noses and small concave on end. 72. Piercer. 73. Knife. 74. Biface flake fabricator used on both lateral margins. 75. Biface coroid fabricator. 76. Bipolar flake fabricator of quartz,

around the convex distal end to form a large but shallow concave 4 cm. long at the end of the other margin. Some of the small concaves are worked from the outer face and some from the inner face.

NORMAL FLAKES AND BLADES.

Elouera adze-flake (Figures 60–64).—This implement out-numbers all other types in the normal flake and blade group in this industry. Thirty-four of the examples are less than 3 cm. and 39 more than this length. The latter series consists of 22 of type i, 8 of type ii, and 3 of type iii, there being six broken and indeterminate specimens. Twenty-nine are abrupt-trimmed on one edge, which is the inner edge on the great majority, and 9 on both edges, whilst one is untrimmed, on the thick lateral margin or back. Seventeen are scraper-trimmed, 9 bear knife or saw use, 7 are use-polished, and 6 are unused on the chord. The chord is straight on the majority but varies from convex to shallow concave on the others. Among the use-polished edges five are straight and 2 convex, and on 6 of them the polishing is on an edge trimmed on one or both facets, but the remaining one has a perfectly straight smoothed edge. In shape the *elouera* are mostly elongate blades, but they range from slender to broad, from thin to thick, and from blades to almost semi-circular flakes. Ten are straight on both ends. One has a faceted butt, and one has a chisel-edge on the distal end. One has a very thick trimmed back and the two flat cleavage faces forming its inner and outer faces meet in a straight unused chord; this example is in every respect similar to the *Merna Wadna* adze-flake (McCarthy, 1946, pp. 27, 29, Fig. 109).

Scrapers (Figures 65–72).—The simple side scraper is in the greatest numbers in each layer. One is a pointed blade 4 cm. long with a convex lateral working edge. Most of them are blades. Three from layer E are inverse-trimmed, and one is a cortex-backed asymmetrical blade. None have a faceted butt. They are a poorly developed series from 3·1 to 5·5 cm. long. Among the double side scrapers is a triangular flake 3·25 cm. long, and three reverse-trimmed blades from 3·5 to 5 cm. long, a blade 4 cm. long with a faceted butt, and two flakes 3·5 and 5 cm. long. The end scrapers comprise two flakes 3·5 cm. long with a convex working edge.

The concave scrapers are also abundant as this kind of working edge is of fundamental importance to a people with round-shafted wooden weapons. The specimens include a miscellaneous series of rough blades and flakes from 3·2 to 6·5 cm. long. The concaves range from 5 mm. to 2·5 cm. wide and up to 5 mm. deep. Two bear a butt concave 1 and 1·5 cm. wide and both 5 mm. deep, and on one of them the concave is worked inwards on its striking-platform. The concaves are usually on a thick margin but one is on a thin distal end of a blade. Two have two concaves 1 and 1·5 cm. wide on their lateral margin, and the concave is on the end of 7 specimens, including the two largest pieces. There are three nosed scrapers, one a blade with a tiny rounded nose between two concaves on its distal end, one a thick flake 4 cm. long with rounded noses 5 mm. long and 1 cm. wide at their base, and 4 × 8 mm., separated by deep concaves 1 cm. wide on one end, and one a narrow blade with a pointed nose-like piercer 2 cm. wide beside a concave on the corner of one end. They are from 3·5 to 5 cm. long.

Knives and saws (Figure 73).—The 23 specimens are all blades excepting two flakes, and are from 3·2 to 6 cm. long. Three have a faceted butt which is unusually heavily trimmed on one of them. The lateral margin used for cutting may be a straight, convex or shallow concave edge, and its use ranges from light primary scaling to a well-marked bi-scaling. None are serrated.

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punch-type, used at both ends. 77. Flake fabricator used on both lateral margins. 78. Microlithic *Elouera* of type ii, scraper use on chord. 79. Blade with trimmed convex end and series of small reversed concaves on lateral margin. 80-91. *Microliths*. 80. *Elouera* adze-flake with concave working edge on chord. 81. Lateral concave scraper. 82. Side scraper. 83. Side scraper trimmed on inner face. 84. End scraper. 85. Double side scraper, reverse trimmed. 86. Scaled burin. 87. Burin with plain platform. 88. Bi-marginal point. 89. Bipolar flake fabricator used on four margins. 90-91. Bipolar flake fabricators, punch-type, used at both ends.

Burins.—One is a flake 4·5 cm. long from layer F with a plain platform and a working edge 8 mm. wide formed by three spall-scars. There are three utilized burins with working edges 3 mm. wide formed by a single spall. One thick flake 3·5 cm. long has a small rounded nose between two concaves 1 and 1·5 cm. wide on one lateral margin, and a single spall forms a working edge 3 mm. wide on the other margin at the distal end.

Flake-fabricators (Figures 74–78).—The high ratio of these implements in this industry is notable. Five are bi-faceted on one lateral margin and three on both margins. One of the latter is a thick piece 3·25 cm. long that is undoubtedly a fabricator, and two are thin flakes. The punch-type is represented by 13 specimens, several of which are quartz bi-polar blades, and others are cortex-backed. They vary from thin to comparatively stout pieces, and some are used at one end only. The working-edge is gouge-like on some examples. 3·25 to 4·25 cm. long.

MICROLITHS.

Nuclei.—These are included in the general description of the normal flake and blade cores.

Blocks.—Each of the three examples, which are from 2·5 to 3 cm. long, possesses a small concave on its end or lateral margin.

Elouera adze-flake (Figure 80).—Among the 34 specimens 21 are of type i, 6 of type ii, and 7 of type iii, a ratio which differs slightly from that of the shell-midden workshops on the south coast of New South Wales (McCarthy, 1943, p. 132). Twenty are trimmed on the inner edge and 14 on both edges of the thick margin or back. Twenty-two are scraper-trimmed, 7 bear signs of cutting use, and 5 are unused on the chord. Three bear a concave on the chord, including one 1·5 cm. wide and 3 mm. deep, and a small reverse-trimmed concave 1 cm. wide. Several bear a small concave on the inner edge of the back. One 2·8 cm. long is a stout example worked on both edges of the back, of which the inner edge is a long shallow concave with a humped nose on one corner and a piercer-like projection on the distal corner of the chord. They are all elongate blades, excepting one broad flake, and range from 2·5 to 3 cm. long They do not resemble the geometrical segments in workmanship.

Scrapers (Figures 82–85).—There are 39 side scrapers from 2 to 3 cm. long, consisting of 11 irregular flakes and 28 blades. The trimmed edge on some is a long shallow concave. Three blades are inverse-trimmed and there are two double-side reverse-trimmed blades. Some of the blades are cortex-backed and asymmetrical. One is a narrow abrupt-trimmed blade, three are keeled side and end scrapers, and one has a faceted butt. Among the end scrapers are two triangular flakes abrupt-trimmed on their wide distal end, being of a type common in the Bathurst district (McCarthy, 1943, p. 206, Fig. 25).

Among the 16 concaves (Figure 81) are 12 narrow and medium blades and 4 flakes. The majority possess one concave only, but some have two, and they range in size from 5 mm. to 2 cm. wide and up to 4 mm. deep. One has a long shallow concave along one margin. One has a faceted butt. They are from 1·8 to 2·9 cm. long. One has a nose between two concaves 1 and 1·5 cm. wide and 2 mm. deep on its distal end. The concave working edge is usually steep-faced on a thick edge.

Knives and saws.—All but two are from narrow to medium blades. One is heavily bi-scaled along its working edge, and one has a crudely serrated edge. The cutting edges are either straight or convex. From 2 to 3 cm. long.

Burins.—In layer F were found two examples. One (Fig. 87) is a blade 3 cm. long on which the plain platform is the striking platform of the blade, and its working edge, 5 mm. wide, is formed by a single spall. The other one (Fig. 86) is a triangular flake 2 cm. long with a convex-scaled platform and a working-edge 4 mm. wide formed by a single spall. The burin from layer D is a thick flake 2·98 cm. long with a small platform at one end, a working edge 5 mm. wide, and a trimmed lateral margin below the short spall-scar.

Bi-Marginal Point (Figure 88).—One example 2·5 cm. long, with a broad rounded butt end, and a short oblique distal end. The margins are not trimmed right along to the butt.

Piercer.—A narrow blade 2·5 cm. long with a short piercer at one end and two concaves almost 1 cm. wide on the same margin.

Flake Fabricators (Figures 89–91).—There is a surprisingly high number of these less than 3 cm. long, and the punch-type is the commoner kind. Eleven are used on one lateral margin, sometimes on one surface only, and 5 on two margins, 3 on one lateral margin and one end, one on two lateral margins and end, and two on one end. They consist of flakes and blades, mostly rectangular in shape, many of which are trimmed on both inner and outer face. They range in size from 2·5 × 2 × 1 cm. to thin blades 2·5 long and 1·25 cm. wide. Three are of quartz.

Among the punch-type 14 are used at one end, 20 at both ends, one on three margins and one on four margins. One-third of them are quartz, and one-third are obvious bi-polar flakes. The punch-type consists of elongate blades, approximately rectangular in shape, from 7 mm. to 2 cm. wide, thick at one end or in the middle, and a small number are very flat, thin blades. One is a nucleus 3 cm. long, with two striking-platforms at right angles, and each gouge-like working edge is heavily splintered and battered by use as a fabricator. They range from 1·7 to 3 cm. long.

Many of these trimming flakes are faceted all over both surfaces. The working-edge may be straight or gouge-like, and it varies considerably in strength among the range of specimens which may be thin and frail or fairly stout and strong.

PERCUSSION STONES.

The small number of hammerstones in the industry is surprising. Two are oval quartz pebbles, 4 and 4·5 cm. long, used at each end, and one is an oval pebble 7 cm. long by 2·5 cm. thick used on its lateral margin only. They are all lightly worked. The finest fabricator (Figure 106) is an oval pebble 14 × 8 × 4 cm. in size, with a trimmed biface lateral margin along its thinnner side on which the edge is battered from percussion use.

EDGE-GROUND IMPLEMENTS.

AXE-HEADS.

Windang Uniface pebble axe.—One example from layer D is elongate-oval and straight-sided in shape, and is 12 × 6 × 3 cm. in size and 12 oz. in weight. A strip has been broken off right along one lateral margin. This axe-head is ground on both facets at a steep angle, and bears percussive marks on its butt and two anvil-pits on both surfaces adjacent to the convex blade.

One end of a pebble, 9 cm. wide and 4 cm. thick, is flaked on one surface round its margin, and it has a use-polished area opposite it on the end of the other cortex surface; these two facets form a straight edge. Although not actually ground, this implement no doubt served a similar purpose to the *Windang* axe-heads.

Pebble axe-heads.—There are two from layer D and one each from layers E and F. They are from rectangular to elongate-oval in shape, and are 9 × 6 × 2, 13 × 7 × 3, 15 × 9·5 × 2·5 (Fig. 105), and 10 × 7 × 3 cm. in size, and from 14 oz. to 1½ lb. in weight. The ground facets of the convex blades form angles of from 70 to 90 degrees, being steep and well marked off from the cortex surfaces. The facets show striations due to the method of grinding which run parallel with the long axis of the implements.* Several bear flake-scars at the butt-end and on the lateral margins, and the butt of one is lacking, due to percussive use. All bear the latter marks on the butt and one has two anvil-pits on its butt. They all display percussive use on both surfaces, mostly near the blade, but on one in the middle, and it varies from a shallow bruising and gashes to deep anvil-pits. They are flat or slightly convex on both surfaces.

A trimmed pebble axe-head from layer D is oval in shape, 12·5 × 9 × 2·5 cm. in size, and 1 lb. in weight. One surface is almost wholly but crudely flaked, and also half of the other surface. The convex blade end has been trimmed preparatory to grinding the facets but the latter process has only just been begun on one facet only.

Biface coroid axe-head.—One fine example (Fig. 104) of the type was found in layer D. It is elongate-oval in shape, 12·5 × 8·5 × 4 cm. in size and 1½ lb. in weight. It is round in transverse section and bears percussive use on one surface and on the flat butt. The ground blade is wide and convex.

Additional axe-heads.—It should be noted that about eighteen edge-ground axe-heads were dug out of the western end of the deposit by collectors and we secured two more from the shallow deposit outside the cave.

Bulga-knife.—Only one complete example (Figure 108) was present. It is a typical elongate-oval segment 11 × 6·5 × 1·5 cm. in size. The ground blade is slightly convex and well made with the facets at a steep angle. One surface bears about a dozen fine parallel scratches 1 cm. long, and there are two on the other surface, one of which is 5 cm. long. This example, and half of another one, each has one cortex and one cleavage surface, and they came from layer E. From layers E and D, however, we got two blanks of this implement. They are both side-blow slices with one cortex surface, and are 11 × 7 × 2·5 (Figure 107) and 7 × 5·5 × 1·7 cm. in size. The outer margin is trimmed to a crescentic shape. On one the latter margin is battered, and its chord is use-polished.

Composition of the Eloueran Industry.—It will be seen from the description and table that the most important specialized implements in the Eloueran industry are the edge-ground axes of *Windang*, pebble, and biface coroid types, the edge-ground *Bulga*-knife, and the *Elouera* adze-flake. The nuclei are the same as those in the Bondaian industry, with the addition of those with alternate platforms. It should be noted that the concave working edge is one of the most abundant types, indicating a wood-working industry of round-shafted weapons and other implements characteristic of all Australian aboriginal culture. There is one *Worimi*-cleaver, blocks, slices and long blades are rare, simple side scrapers and knives are common, burins are poorly developed and uncommon, chisels are abundant and use-polished working edge is fairly common. Microliths less than 3 cm. long are best represented by the side scrapers, *Elouera* adze-flakes and chisels.

Specimens Found Outside the Cave.

After completing the excavation within the cave, a section 1·4 metres wide was commenced on the outside. Almost immediately difficulties were encountered. Very large rocks occurred 30 cm. and more below the surface and these had to be removed to ascertain whether there was an occupational deposit beneath them. Bedrock was eventually reached at a depth of almost 2 metres, but the lower metre consisted of sandy soil in the crevices and was barren of implements. Implements were found to a depth of approximately one metre or less, and it was therefore considered unnecessary to remove the large closely-packed rocks deeper than half a metre in this outside area. There is, of course, no definite method of correlating the implements found outside with the two industries occurring within it, but from the general formation of the site it is considered that the greater portion of the outer deposit was built up after the deposit inside the cave had grown sufficiently to spread out over the platform of rocks. The implements from outside would, therefore, be grouped chiefly with the more recent or Eloueran industry, a conclusion supported by the presence of the edge-ground implements, and the relatively numerous *Elouera*. Moreover, one of the only two *Bondi* points found here was from a depth of 33 cm., and the other one, found on the surface, was probably dropped by the collectors who dug out the western end of the cave.

COROID IMPLEMENTS.

Uniface Pebble Implements.—A very weathered pebble, 9·5 × 7 × 2·5 cm., is crudely trimmed along the end of one surface. It is probably an axe-blank.

Nuclei.—Among the single platform type, 4 are cortex-backed, 4 cm. long, and two of them are flat and not very thick. One is a fine example of the chisel-ended nucleus, 3 cm. long, with a dished and faceted striking platform at 99° and the chisel end at 80°. One has a trimmed concave 1·5 cm. wide and 3 mm. deep. There are four prismatic nuclei knapped all round, one of which is a secondary nucleus. They all possess a plain platform, one of which is at an angle of 80°. One is 2·5 cm., and three 3·5 cm. long.

Among the nuclei with two opposite platforms two are chisel-ended, 3 and 3·5 cm. long, one of which has a plain flat striking platform at an angle of 75°, and one a dished platform at 80°. Another one has both plain and dished platforms at 80°, with the flake-scars meeting in the middle of the knapping face. There are two quartz nuclei 3·5 and 4·5 cm. long with cortex platforms at each end. Eight quartz pebbles are crudely knapped.

The re-directing flakes comprise five bolcks with truncated flake-scars.

KNAPPED IMPLEMENTS.

Slices.—A side-blow slice, 10 cm. long, trimmed on the convex thick margin and showing chopper or scraper use on the chord, is similar in shape to the *Bulga*-knife.

NORMAL FLAKE AND BLADE IMPLEMENTS.

Elouera adze-flakes.—There are two of type i, one of type ii, and one of type iii, from 3·3 to 6 cm. long. Those of type i and type ii are trimmed on the inner edge of the thick back, and the type iii specimen on both edges, and all have well trimmed scraper edges on the chord. The type ii example has a utilized burinate edge at the butt end and a shallow concave 1·3 cm. wide at the distal end. The largest specimen, made of grey chert, has a bi-scaled saw edge on the chord, and a spall has been struck off one corner to form a utilized burinate edge 8 mm. wide.

Scrapers.—The four side scrapers, 3·5 to 6 cm. long, consist of two blades and two flakes, one being a side-blow flake with a steep-faced working edge. The two side and end scrapers, 4 cm. long, are on one blade and a flake with a faceted butt. One thick flake 3·5 cm. long has a concave 1·5 cm. wide and 3 mm. deep. A broad blade 4·5 cm. long has a trimmed distal end and a use-polished lateral margin 3·5 cm. long.

Burins.—One with a plain platform, concave, with a single opposing spall-scar 4 mm. wide, and knife use on both lateral margins.

Flake fabricators.—Only one example 3·5 cm. long used on one margin.

There are two narrow blades, unused, with a faceted butt.

Bondi Points.—The two examples are 3·5 cm. long and partly trimmed on the inner edge of the back. Both have a faceted butt. One has three small concaves separated by rounded noses, which is unusually heavy trimming for these points.

Hammerstone.—A round, flat pebble 5 cm. diameter and 1·5 cm. thick used lightly on portions of its margin and one surface.

MICROLITHS.

Eight *elouera* of type i from 2·3 to 3 cm. long are trimmed on the inner edge of the thick back. The chord on four bears knife use and on three scraper trimming. One has a faceted butt. Three others of type i 2·5 cm. long are trimmed on both edges of the back and all bear scraper trimming on the chord.

The eleven side scrapers are from 2 to 3 cm. long. The end scrapers, with convex working edges, are from 2·5 to 3 cm. long, and a reverse-trimmed double-side scraper is a thin blade 2·5 cm. long.

There are three knives from 2·5 to 3 cm. long.

Among the flake fabricators are 7 punch-type used at one end, and 7 at both ends, whilst one is used on both lateral margins. Three of them are of quartz. They are from 2·3 cm. long.

EDGE-GROUND IMPLEMENTS.

Pebble axe-heads.—An example rectangular in shape, 10·5 × 7·5 × 2 cm. in size and 12 oz. in weight. It has rounded corners, is flat on both surfaces, has sharply angled facets on the blade, and bears percussive use on the butt and lateral margins. One of the lateral margins is trimmed from one side only. There are deep and extensive anvil-pits and percussive marks covering an area 4 cm. wide on each surface, adjoining the blade and exactly opposite each other.

Windang uniface pebble axe-head.—An oval specimen (Figure 109), 12 × 7 × 2·5 cm. in size and 12 oz. in weight. It is flaked all round its margins from both sides and their edges are battered. A large flake has been removed by percussive use across the butt end. One surface is trimmed all over and the other only marginally. There are slight percussive gashes on one surface, and it is ground on both facets.

Axe-blank.—An oval pebble (Figure 103) 15 × 10·5 × 3·25 cm. in size, marginally trimmed on both surfaces along the sides and one end.

Axe-grinding grooves.—Several of these occur on a rock outside the cave.

Technique.

The nuclei (Figures 4–25), which are very small in average size, display a mixture of parallel and convergent flake-scars, without any emphasis on either type. Apart from the cortex-backed kind the nuclei are mostly straight-sided prismatic forms, and the pyramidal nuclei are represented by two small specimens only in contrast to their abundance at Singleton (McCarthy & Davidson, 1943, pp. 212–3, fig. 71). As the analysis of the striking-platforms demonstrated in both industries, the plain flat platforms are in the majority, whilst dished and faceted platforms are present in reasonable numbers. Nuclei with single platforms, and with two platforms at opposite ends, are in the absolute majority, alternate and right-angled platforms are uncommon, and compound platforms are absent altogether. Cortex platforms are few in number. Nuclei with pointed, rounded cortex, flat, chisel and keeled ends are all well represented. The chisel end is usually made by the removal of a single flake at a steep angle but on some nuclei this end is a keeled edge used as a second platform. On a small number of nuclei abrasions and splintering occur on an end opposite to a striking platform, indicating the use of an anvil in knapping, and the nuclei are so small on the average that this would appear to be the most practicable method of knapping them. There is very little trimming of the upper end of the flake-scars on the nuclei with a plain platform, although the spurs were removed on many of them. The short blows required, and the relatively thin flakes and blades removed, did not produce many troublesome spurs, so that on these nuclei the edge formed by the striking platform and knapping face is frequently untrimmed. Most of these nuclei, furthermore, are probably in the reject stage.

The dished platforms are mostly formed by the removal of a single flake leaving a concave flake-scar, but on some the flake removed left a narrow flake-scar along one margin of the platform, or two flake-scars are present separated by a median ridge. The re-directing flakes thus vary from elongate narrow to thick block-like pieces. The striking-platforms are mostly elongate or rectangular, but half rounded and triangular shapes are common.

The flake-scars on the nuclei are markedly narrow, although they are frequently short and broad. A high percentage of them failed to run the full length of the knapping face even though most of the nuclei are only 2 to 5 cm. long. The angles of the striking platform and knapping face range on the average between 71° and 91°.

Blades form the great majority of pieces struck from the nuclei. The following series of inner angles were obtained from the 242 flakes and blades possible to measure in both industries: 86 to 90°—3; 91 to 95°—0; 96 to 100°—13; 101 to 105°—17; 106 to 110°—26; 111 to 115°—31; 116 to 120°—50; 121 to 125°—35; 126 to 130°—21; 131 to 135°—5; 136 to 140°—1. Among the *Bondi* points the following result was obtained from measuring 79 with plain and faceted butts: 86 to 90°—2; 91 to 95°—4; 96 to 100°—17; 101 to 105°—19; 106 to 110°—23; 111 to 115°—11; 116 to 120°—3.

Attention is drawn to the fact that the series of lower angles, from 86 to 105°, are mainly those of the pieces with a faceted butt. Even so, there is a remarkably low and consistent series of angles associated with the *Bondi* points. There are, it might be mentioned, in the Bondaian industry, forty pieces with a faceted butt among the normal flakes and blades and microliths, and thirty-four among the *Bondi* points; on the other hand, there are only five pieces among the flakes and blades of the Eloueran industry. The difference between the two industries is probably due to the point technique in the Bondaian industry.

There are forty semi-salient and salient bulbs among the normal flake and blade implements from the two industries.

In the Eloueran industry there is a very low ratio of quartz implements to the vast number of broken pebbles of this material.

Van Riet Lowe (1946), in a recent paper, described the flake fabricators, so-called, as chisels made by the bi-polar method. He stated that a small pebble was held in a vertical position on a stone anvil and was then struck with a hammerstone. In this way, spalls or splinters were often simultaneously removed from both ends or poles of the pebble, as well as from both faces, ultimately leaving a sharply bevelled bifaced chisel-like edge, either straight or like a gouge. All the work is primary, and the shapes of the tools were arrived at by perfectly straight-forward direct rest percussion, and bipolar trimming. The term now generally applied to such tools is chisel, not scraper, which falls within the French descriptive term *ciseau* or under the generic term *outils écailles*. The bipolar technique is of very widespread occurrence as a method of stone-fracture and stone-shaping common to many cultures and climes and not exclusively associated with any particular stone culture or time. The anvils and hammers are scarred, according to the amount of use.

At the Lapstone Creek site these implements (Figures 41, 58, 75–78, 89–91) are either uniface or biface trimmed and used; some are made from tiny pebbles, and others are pieces of pebbles subsequently shaped by bipolar working. The anvil and hammers were chiefly edge-ground axes, although pebbles were also used, but they are scarce in both industries. The bipolar technique explains clearly the reason for the percussive marks in the form of patches of scars and pits on the surfaces of the axes and the battered nature of their lateral margins and butts due to use as hammers. These remarks apply, of course, to sites elsewhere, and it might be remarked that the elongate pebble hammer-anvils so abundant on coastal middens form perfect implements for use as anvils and hammers in bipolar knapping and trimming. Van Riet Lowe suggests no use for these chisels. I have previously considered them to be flake and blade trimmers but, judging from the small number associated with the *Bondi* points at the Emu site, it is improbable that they are point trimmers. They occur in large numbers with the *elouera* adze-flakes in the Eloueran industry and might have been used for retouching the working edge of this implement.

Fauna.

One surprising result of this excavation was the almost entire absence of animal bones and mollusc shells. In layer F in various parts of the deposit we obtained a few small pieces of bone only 2 cm. long, some of which are burnt fragments. There is also a fragment of a fresh-water mussel shell (*Unio* sp.) and two complete snail shells (*Strangesta strangei* and *Meredolum depressum*) from layer F. Layer E yielded several more fragments of burnt bone. No shell or bone implements were found. Therefore a list of the foods of the inhabitants of the rock-shelter cannot be made.

III. COMPARISON OF THE BONDAIAN AND ELOUERAN INDUSTRIES.

The similarities in these two industries are: (*a*) The same kinds of nuclei and knapping techniques, although the faceted butt technique was used more commonly to produce the *Bondi* points in the earlier industry than it was in the later industry; (*b*) a similar range of scraper and knife flakes and blades; (*c*) a scarcity of blocks, slices and long blades; (*d*) the presence of the use-polished working edge; (*e*) the presence of vast numbers of thin and small scraps and flakes which might have been used as "barbs" on the death-spears (Hunter, 1793, p. 496) which were used in this area.

The differences are marked and of great importance in the study of Australian prehistory. The edge-ground implements—axe-heads and *Bulga*-knife—and the *Worimi* cleaver occur only in the Eloueran industry, the *elouera* and trimming flakes are both abundant in the Eloueran industry and uncommon in the Bondaian industry, and the *Bondi* point is restricted entirely to the Bondaian industry.

Among the microliths the same kinds of flake and blade implements as given above for the larger normal series, are most abundant in the two industries, but here, too, the *elouera* and trimming flakes are plentiful in the Eloueran industry and uncommon in the Bondaian industry. Furthermore, 125 *Bondi* points out of 182 are less than 3 cm. long in the Bondaian industry. Only one geometrical microlith was found, it being a segment in the Bondaian industry in which were also present a few thumbnail and discoidal scrapers and oblique trimmed blades. Trapezes and triangles are entirely lacking.

In regard to material there is a gradual change from an abundance of grey to green cherts and quartzites, with a very small amount of quartz, in the Bondaian industry, to an enormous increase in the quantity of knapped quartz pebbles and flakes although very few of the latter show any signs of use. Most of the materials are derived from either the ancient beds of the Nepean River on the side of the Mountains, or from the pebbles in the existing river bed.. One implement, a flake of silicified wood, might have come from the coastal middens between Bondi and Bellambi, from thirty to fifty miles away, where this material was commonly used. In the Bondi industry a few *elouera* and points are made of a light-grey chert similar to that used in the Hunter River basin, but it is of local origin.

The cultural development that took place at this site is difficult to interpret. There is no evidence to indicate a break in the occupation. The change, however, involved entire abandonment of the *Bondi* point, the greater use of the *Elouera* adze-flake, knives and trimming flakes, and the adoption of the edge-ground axe and *Bulga*-knife. At present I cannot perceive any relationship in form or function between the edge-ground implements and the *Bondi*-point, or, on the other hand, between the latter and the *Elouera* adze-flake, in function. It is surprising to note, furthermore, that no choppers occurred in the Bondaian industry. If the *Bondi* point was a dual spear-barb and point, as I believe it was (McCarthy, 1943A, p. 149), then it might have been replaced by a wooden barb, but none of these were found, or by the thin flakes of stone and shell with which the death-spear was armed. Obviously, as I have shown (McCarthy, 1940, p. 262), the edge-ground technique was in process of diffusion in Australia, but for some reason it was accompanied at this site and probably elsewhere by an elaboration of the use of *Elouera* and trimming flakes.

IV. ABORIGINAL RELICS IN THE EMU PLAINS–CASTLEREAGH AREA.

Within a comparatively small area occurs an interesting series of other relics left by the aborigines, and their relationship to the Bondaian and Eloueran industries is important.

i. Surface Workshops.

The most important sites (Figure i, No. 2) are extensive workshops for the production of uniface pebble implements, edge-ground axe-heads and *Bulga*-knives, all of which have been collected on the surface or turned up by the plough on the rich farming and dairying flats in this area. I have, fortunately, been able to examine a large series of these implements comprising 46 in the Australian Museum, 106 in the C. C. Towle Collection of Stone Implements (Australian Museum), and 268 in Mr. G. Bunyan's collection. Thorpe and Stanley (1928) gave a brief description of the workshops and some of the implements. The main site is an extensive area at Castlereagh which extends for half a mile along and back from each bank of the river, in the bed of which is an inexhaustible supply of pebbles. There are four other workshops to the south, as shown in Figure 1, and one of these is traversed by Lapstone Creek just below the rock-shelter. The most favoured material among the Nepean pebbles for the large implements is hornfels, although a wide range of other stones is present. Axe-heads of the same kinds occur in the whole of the area eastward to the coast but they are not included in this study.

i. *Uniface pebble axe-blanks.*—These are classified according to the amount of trimming.

(*a*) *End* (Figure 119).—Sixty-nine specimens ranging from 9·5 × 5·5 × 1·25 to 23 × 11 × 4 cm. and from ½ to 3 lb. in weight. Thirteen only bear signs of percussive use as hammerstones on the butt. One bears use-polishing on both facets of its trimmed end. On most of them the trimming appears to be for the purpose of eliminating the thick edge that would otherwise have to be ground away in the making of an axe-head, and on several, specimens the trimming is taken back to the middle of the pebble. There are eight large examples in the series. One (Figure 120), 17 × 14 × 4·5 cm., 3⅝ lb. in weight, has a very thick end on which the trimmed edge is pointed in the middle, the butt is hammered, and it appears to have been used as a chopper. Another one, E.33235, figured by Thorpe (1932, Pl. ix, fig. 5), is 18·5 × 10·5 × 5·75 cm. and 3 lb. 4 oz. in weight.

(*b*) *Lateral* (Figure 116).—Seven examples ranging from 9·5 × 5 × 1·5 to 18 × 10 × 3·5 cm. and from 5 oz. to 2½ lb. in weight. The smallest one (Figure 117) is a thin flat pebble with a concave working edge 4 cm. wide and 1 cm. deep.

(*c*) *Lateral and End.*—Forty-two specimens ranging from 11·5 × 8 × 2 to 18 × 15 × 2 cm. and from 1 to 3 lb. in weight. Nine of the series are large in size. One (Figure 121) is trimmed right along both lateral margins, one on one lateral margin and both ends, and one is semi-biface trimmed. On two specimens the thicker butt end is trimmed instead of the usual thinner end of the pebble. The trimming is mostly steep-faced in nature. Eight are trimmed on one end and one lateral margin, 14 on one end and half-way up both lateral margins, and 16 on one end and right along both lateral margins. One is an elongate narrow example, 15·5 × 7 × 3 cm., and of an uncommon type. Four are hammered on the butt.

(*d*) *Uniface.*—Nine specimens forming a mixed series. One oval example (Figure 118) 14·5 × 10 × 2·5 cm. and 1⅜ lb. in weight is flattened and not very thick, has a trimmed oblique edge at one end, and the trimming all round its margins has left an island of cortex in the middle. Two others of similar type are 14 × 9 × 4 and 17·5 × 12 × 3 cm. in size and bear percussive marks on one surface. Two specimens have been formed by the removal of a large slice, leaving a narrow band of cortex at one end, and their margins are trimmed. Three examples are flaked all over one surface. Two of them have steep-faced margins. The third one is a true *Sumatra*-type, 12 × 7·5 × 4 cm., oval in shape, amygdaloid in form with a high crown at one end; its edges are trimmed all round, and are well used, particularly the straight edge at the thick end. The occurrence of this specimen might be merely fortuitous and of no cultural importance, but on the other hand it may indicate the possibility of the existence of the older Kartan uniface pebble culture in this area.

(*e*) *Split-pebble Slices.*—Eleven specimens, one of which is broken at one end, ranging from 11 × 9·5 × 4 to 15 × 14 × 4 cm., and irregular in shape. One is trimmed along the straight end and lateral margin, two on both lateral margins and convex end, two on both lateral margins, two on one straight lateral margin, and three (Figure 115) right around. One of the latter is pseudo *Sumatra*-type in appearance. Several of them are similar in form to the *Bulga*-knife and are probably blanks.

(*f*) *Worimi Cleaver.*—A large and thick slice with outer cortex and inner cleavage faces. It is 18 × 10 × 5·5 cm. The outer edge of its thick back is worked right along the lateral margin and both ends, and its chord is steeply trimmed.

ii. Edge-ground Implements.

AXE-HEADS.

(*a*) *Windang-type.*—The 84 examples vary considerably in the amount of trimming on the one surface so treated. Fourteen are trimmed on the blade end only (Figure 111), 12 along one end and lateral margin (Figure 113), 31 along one end and both lateral margins (Figure 123), and 9 all over one surface (Figure 126). One is trimmed round the butt end only (Figure 124), three are semi-uniface trimmed, and 12 are split-pebble slices. The blade is ground on the lower cortex facet on 5, on the upper trimmed facet on 8, and on both facets on the remainder. The butt is hammered on 28, and of these 15 bear percussive marks, including several with a deep anvil-pit, on one or both surfaces. Two are broken transversely at one end. One (Figure 122) unusually well fashioned rectangular example, 11 × 10 × 3 cm., is trimmed along both lateral margins, hammered on the butt, ground on both facets of the blade and also along one lateral margin. They range from 8 × 6 × 1·5 to 20 × 14 × 4 cm., and from 3 oz. to 3½ lb. in weight. There are 12 large examples in the series.

(*b*) *Pebble Axe.*—There are 130 axe-heads consisting of a plain pebble with a ground blade at one end, 14 of which are broken either transversely or lengthwise. Twenty-two of them are large axes. The blade is convex on the great majority and straight on the remainder. One is a cylindrical and curved pebble, 18 × 6 × 4 cm., and is exceptional in shape, all of the others being broad and flattened pebbles (Figure 112), excepting about a dozen chisel-like specimens, narrow and thin, 8–13 cm. long, 4–6 cm. wide, and 1–2 cm. thick. All but 20 of them are hammered on the butt, there are percussive marks on about one-quarter of the series, but a small number only bear anvil-pits (Figure 114) of any depth. One lacks a large flake on one facet of the blade due to use, and it has a ground facet along one lateral margin, and percussive use has removed flakes on the butt of a number of specimens. One axe has an oblique line of incised parallel lines about 1·25 cm. long in the middle of one surface. They range from 9 × 6 × 1·25 to 15 × 11 × 2 cm. and from 5 oz. to 2 lb. in weight, most of them being less than 3 cm. with a maximum of 4 cm. in thickness.

(*c*) *Trimmed Pebble Axe.*—The 52 examples all possess a convex blade. The butt, and the lateral margins, after preliminary trimming on both facets, are hammered on almost all of them (Figure 127), and this use has removed large flakes on some specimens. Six are trimmed and hammered along one lateral margin only (Figures 113–4). Fourteen have a deep anvil-pit on one or both surfaces. This variety of axe-head, therefore, can be regarded as a hammer-axe in function to a greater degree than the other varieties. They range from 10 × 7 × 1·5 to 16 × 9·5 × 2·5 cm. and from 9 oz. to 1¼ lb. in weight.

Axe-blanks and Axe-heads.—A comparison of the trimmed uniface pebbles and the axe-heads above described demonstrates an intimate relationship. The end-trimmed pebbles are blanks for the making of the edge-ground pebble axe-head, and these two types are the most abundant in their respective groups. All of the other uniface pebbles—trimmed on one lateral, the end and one or both lateral margins, all round, or all over one surface, or the split-pebbles—are represented in the edge-ground *Windang*-axe series, and are, therefore, to be considered as axe-blanks also. On the other hand, there can be no doubt that some of these uniface pebbles served as choppers and scrapers, but they are in a marked minority. Attention might also be drawn to the lack of percussive use on the trimmed uniface pebbles, and it is apparent that their use as hammers and anvils was principally after the grinding of their blade.

(*d*) *Biface Coroid Axes.*—The four specimens are all ovate in shape, 11 × 8 × 3 to 12 × 7 × 3·5 cm. They are all hammered on the butt, and there are anvil-pits on both sides of one. One specimen is made of a dark-coloured igneous material and appears to be an axe traded from the Mountains.

(*e*) *Pecked Axes.*—There are seven examples from these workshops, all in the possession of Mr. Bunyan. Five of them are elongate, with round to oval transverse section, from 10 × 5 × 4 to 15 × 7 × 3·5 cm., and all hammered on the butt. Two are hammered on the butt and blade, the latter being flattened, and one (Figure 131) of these has a second ground-edge blade at the other end. These five specimens are typical of the pecked round-axe found throughout eastern New South Wales, but their scarcity on these workshops suggests that they came by trade, a conclusion supported by the dark igneous material of which they are made. Two others are local pebbles about 15 × 9 × 3 cm., on which the pecking was begun in a narrow band adjoining the blade.

(*f*) *Pecked and Grooved Axes.*—Two exceptionally fine specimens from Castlereagh, the only examples known from the workshops, are in Mr. Bunyan's collection. One (Figure 125) is oval, 19 × 13 × 3 cm., and 3 lb. in weight, with a polished central groove, the other is pear-shaped, 21 × 11 × 3 cm., with a pecked central groove and a bevelled butt edge roughly trimmed. They are both flattish pebbles pecked on the semi-circular blade. Grooved axe-heads are extremely rare in the central coastal area of New South Wales, and these two examples are unusually large and flat, although they conform to the general shape of axe used in the Emu–Castlereagh district. The Australian Museum possesses another grooved axe from the Nepean River, 12 × 9 × 5 cm., 1¾ lb. in weight, and bearing anvil-pits on its surfaces.

BULGA-KNIFE.

There are four fine examples from the Castlereagh workshop. Three of them are crescentic in shape, from 9 × 6 × 3 cm. to 11 × 9 × 2·5 cm., and side-blow slices with their blades ground on both facets. One is a trapezium in shape, 13 × 9 × 2·5 cm. Their working edges are either slightly convex or straight. Another one is a rectangular uniface slice 9 × 6·5 × 2 cm., but its edge is unground and it is therefore a blank. At least three others were found by Mr. Bunyan in this locality.

iii. Percussion Stones.

(*a*) *Pebble.*—The ordinary pebble hammerstone is scarce on the workshops, although there are 27 specimens. These are oval to round in shape, 6 to 13·5 cm. long, and 1·5 to 4·5 cm. thick (but mostly 2 to 3 cm.). Two (Figure 129) have trenches of several anvil-pits down the middle of each side and they are also battered all round their margins. One is a concavo-convex pebble 12 cm. in diameter, and another one is a large waisted pebble 17 × 12 × 5 cm. One (Figure 128) is a rounded *kulki*-type with anvil pits on both surfaces and round the battered cylindrical sides; it is an oval pebble 8 cm. long and 4·5 cm. thick. The general use of the edge-ground axe as a hammer-axe took the place of the pebble percussion stone to a large degree.

(*b*) *Biface Coroid.*—There are 19 trimmed pebbles battered by use on the butt and lateral margins (Figure 130). Three of them are roughly trimmed on one surface only. One is an elongate pebble with a well trimmed bi-faceted lateral margin used as a fabricator. They range from 10 × 7 × 3 to 18 × 10 × 2·5 cm., and from 8 oz. to 1⅝ lb. in weight.

One oval pebble, trimmed all round its margins on both surfaces, and 14 × 14 × 3 cm., has an oblique face, rubbed flat, 6·5 cm. wide at one end.

(c) *Hammer-axes.*—Eight edge-ground pebble axe-heads have their blades flattened by percussion at a face up to 5 mm. wide. The butt is also hammered on two of them. One is an elongate pebble, 22 × 7 × 1·5 cm., and 2¼ lb. in weight. One of the blades on the double-ended pecked axe (Figure 131) has been flattened in this way.

The general type of pebble used for the above implements is not very thick, is either flat or only slightly convex on both surfaces, is short to long oval and commonly tending to a rectangular form, and has straight or convex lateral margins. This is the general type found in the gravel deposits and very little discrimination was needed by the natives in selecting the pebbles used for implements.

iv. Knapped Implements.

Blocks, slices, normal flake and blade implements occur scattered intermittently throughout the workshops. They are not very plentiful now because the area has been turned over by the plough for a very long period of time. They include *elouera* adze-flakes, which are plentiful, but the *Bondi* points are very rare. It is probable that the river floods have washed these implements from the open camp-sites and distributed them over the flats where silts have covered them.

2. Axe-grinding Grooves.

At Lower Castlereagh (Figure 1, No. 3), on the eastern bank of the main channel of the river between Black's Falls and Rose Falls, the sandstone outcrops for half a mile in horizontal beds now forming a series of narrow and broad ledges, whilst there are many large blocks which have been broken off the outcrops and washed into the river bed during periods when the river has been at a high level. The lower series of ledges, and many of the blocks, are thickly covered with an immense number of grooves from 15 to 60 cm. long, 2·5 to 8 cm. wide, and 1·5 to 6·5 cm. deep; the whole series can only be seen when the river is very low during the summer months, or in times of drought. The great majority (Figures 101–102) are axe-grinding grooves, and these are relatively short and broad, up to about 32 × 5 × 3·5 cm. Here and there are long narrow grooves which were used to smooth the surface of spears, and these are about 50 × 4 × 1·5 cm., whilst some of the axe-grooves have also been used for this purpose. The most remarkable grooves (Figure 101), however, are very long, wide and deep, those measured as examples being 60 × 8 × 5, 55 × 5 × 2·5, 53 × 7·5 × 5·25, and 50·5 × 3·5 × 3·5 cm. These are also to be seen here and there, and one series of eight side by side was noted. Some of them occur on the vertical ends and faces of the rocks and these are very deep, being up to 15 cm. These large grooves were probably produced by rubbing in them wooden club-heads and digging-sticks, and also axe-heads, to smooth the surface; a straight shaft will not fit into them because their deepest point is in the middle and both ends are shallow. Their edges are sharp whilst those of the axe-grooves and spear-grooves are rounded and frequently only slightly convex.

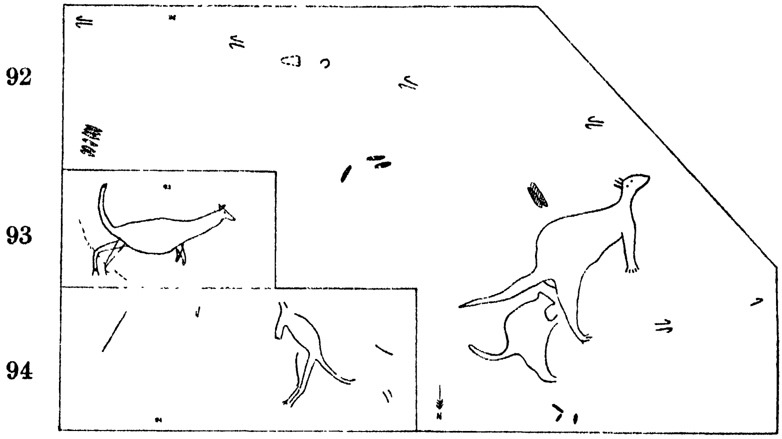
It is obvious that this grinding workshop was used for a very long period of time, and it is probably the most extensive site of its kind in the central coastal district. Axe-grooves in varying numbers are also scattered about the creeks and rock surfaces of the foothills and gullies in this Blue Mountains' scarp.

It appears probable, furthermore, that this site was in actual use when the First Fleet explorers penetrated this area. Hunter (1793, pp. 450–1) stated that on the Hawkesbury river, in the vicinity of Richmond Hill which is about 6 miles north of Castlereagh, an old native in a canoe was met by Governor Phillip's reconnaissance party. He was well known to *Colebe* and *Ballederry*, two natives from Port Jackson who accompanied the Governor, and they concluded that the old man and his companions in the canoe had made the journey up the Hawkesbury river in order to procure stone hatchets. The natives got the stones from a part of the river near Richmond Hill, which the old man said was a great way off (for him) and the road to it pretty bad. *Colebe* and *Ballederry* also stated that because of the long distance overland to the place where the hatchets were obtained, the natives had to visit it in canoes. There was a good native path running alongside the river. A hafted axe was dug up on the bank above the axe-grinding grooves by a resident many years ago.

Mr. Bunyan possesses several large portable axe-grinding stones. One is only half of the specimen but it is 30 × 24 cm. and bears several grooves on each side whilst its rounded margin appears to have been formed by trimming and rubbing. It was revealed by an excavator-grab at a depth of forty feet in a gravel island in the river bed.

3. Rock Engravings.

There are three sites of rock engravings at Castlereagh. One (Figure 94) is on a large rock surface in the river bed bearing axe-grinding grooves. Two kangaroos are engraved here, and old residents claimed their parents told them that these figures were cut by a local native more than eighty years ago with a steel tomahawk that he got from one of the settlers. Both figures are incomplete, and an examination of their outlines revealed that the smaller one was undoubtedly made with a steel pick and it shows a different art style from the characteristic engravings of these animals. The large one is a genuine engraving by the aborigines re-done in parts with a pick. There are several short lines and one kangaroo track near by, all with conjoined punctured outlines 1·5 cm. wide and 5 mm. deep, suggesting that there were other figures now weathered away. Weathering is a rapid process here because of the river running over the engravings at frequent intervals. Thus it is interesting to note that the local story is partly true, and also to see the difference in the art styles of the old and recent engravings.



Figures 92-94. Rock engravings.

92. Kangaroo hunt at foot of Hawkesbury Lookout road. 93. Kangaroo on rock between Nepean River and Hawkesbury Lookout road. 94. Kangaroo and its track, with two curved lines, on one of the rock surfaces bearing axe-grinding grooves. Scale ⅛ inch to 1 foot (30 cm.).

The second site is half a mile west (Figure 1, No. 4) of the above one, on portion of a low ledge of rock on the 50-foot contour line half-way between the river and the Hawkesbury Lookout Road. The rock is flat in parts, and slopes from south to north. On it is engraved a kangaroo (Figure 93) 180 cm. long, with outlines of conjoined punctures 1·5 to 2 cm. wide and 4 mm. deep, in a coarse flat part of the rock. The animal is rather elongate in formation, and is posed as though it is either alive and lying down, or a dead animal traced around by the artist. One eye is shown, the toes are indicated on the hind legs, and an unusual feature of it is that both pairs of limbs are crossed.

The third site is about half a mile south-west (Figure 1, No. 5) of the second one. It is at the base of and beside a bend in the Hawkesbury Lookout Road, and is on the southern slope of the bottom of a deep gorge on the northern side of the road. The site is a large rounded and isolated outcrop of sandstone, sloping from south to north, with a steep face on its northern and western sides. A kangaroo hunt (Figure 92) is engraved across this rock. A magnificently portrayed buck with a doe close behind him is posed in full flight to the westward. The buck has three ears, two eyes, toes and fingers, but the doe lacks all these details. Four pairs of large kangaroo tracks about 180 cm. apart lead away to the south-east, whilst one pair and a single one are directed to the south-west. The outlines of these kangaroos and tracks are all smooth rubbed grooves 2·5 to 4 cm. wide and 1·25 cm. deep, very distinct and well preserved.

There is a small circular outline showing punctures 1·5 cm. wide, but shallow, between two of the pairs of kangaroo tracks, but the balance of this figure has been chipped away by a vandal. A human foot-like outline occurs near one pair of tracks but it is now impossible to say whether it is an engraving or not. Axe-grinding grooves are scattered about as shown in the diagram.

In the northern face of the rock is a small rock-shelter, the deposit on the floor of which has been dug out by campers. Implements scattered about as a result comprise normal flake and blade scrapers, *elouera* adze-flakes, and edge-ground pebble axes, but no *Bondi* points have been found to date, so that the site would appear to belong to the Eloueran culture period.

4. Human Hand Stencils.

In a gully about one and a half miles north of Lapstone Creek is another rock-shelter in the bed of a creek (Figure 1, No. 6) whose waters run over the floor of the cave. Its wall and ceiling are decorated with about seventy-two red stencils of the human hand (Figure 100), but there is no occupational deposit on the floor. This shelter was evidently a favourite rendezvous as a cool resort in the summer.

5. Fish-trap.

Just above the axe-grinding rocks is a pebble-bar across the Main Channel (Figure 1, No. 7) of the Nepean River, and it is known as the Black's Falls (Figure 99). At the present time there are two roughly parallel rows of large boulders across this bar which are believed to have formed the basis of a weir for catching fish. Logs, which are washed down by the stream, if placed against these boulders to form a weir of two walls, would have formed a simple trap in which the imprisoned fish could be speared with ease. The large boulders are covered when the river rises, and there is a long deep stretch of the river above the bar.

Bondaian and Eloueran Culture Material from other Stratified Sites in Eastern New South Wales.

Bondaian Culture.

The following rock-shelters have yielded implements of the Bondaian culture:

1. *Lapstone Creek.* A small rock-shelter higher up Lapstone Creek than the cave dealt with in this study. A mixture of Bondaian and Eloueran culture implements (McCarthy, 1934, and 1943, p. 150).

2. *Gore Creek, Lane Cove River.* Eight scrapers, 1 microlithic *elouera* adze-flake, 3 *Bondi* points.

3. *Harris's Flat, Wollombi.* Two rock-shelters containing stencils of human hands and weapons, drawings and paintings (Hammond, 1892). A test-trench in one of these deposits yielded 11 nuclei (10 microlithic) comprising both cortex-backed and completely knapped kinds with one or two striking platforms, 1 quartz nucleus with indiscriminate platforms, 1 small trimmed block, 3 narrow re-directing flakes, 2 *elouera* adze-flakes, 1

side-scraper, 1 knife, 2 bi-polar flake fabricators, one of punch-type, 2 microlithic end scrapers, 1 use-polished blade, 54 *Bondi* points.

4. *Hoolahan's Farm, Howe's Valley.* A test-trench yielded 3 nuclei (microlithic, 1 single and 2 with opposite striking platforms), 1 quartz nucleus; 2 side-scrapers, 1 concave and nosed scraper, 1 oblique trimmed blade, all microliths; 8 *Bondi* points.

5. *Merrick's Farm, Howe's Valley.* A rock-shelter containing human hand stencils. A test-trench yielded 3 nuclei (microlithic, 2 with one and one with 2 striking platforms); 1 discoid scraper of quartz, 1 end scraper, 1 oblique trimmed blade, all microliths; 2 bi-polar flake fabricators used at one end, 12 *Bondi* points.

6. *Winter's Run, Jerry's Plains, Hunter River Valley.* Two re-directing flakes, 1 *elouera* adze-flake, 1 end scraper, 1 *Tula* slug, 1 side scraper and knife, 2 concave scrapers, 3 microlithic bi-polar flake fabricators, 1 notched blade, 18 *Bondi* points, including two with concave working edges on chord, 1 microlithic *elouera* adze-flake heavily used on chord, flakes and blades with faceted and plain butts.

7. *Dural Station, Jerry's Plains, Hunter River Valley.* One end scraper, 1 butt-end concave and nosed scraper, 1 knife, 1 scaled burin, 17 *Bondi* points. Faceted and plain butts are represented on the flakes and blades.

8. *Milbrodale.* A rock-shelter on Dodd's Farm which contains a large culture-hero drawn in red ochre, white lines, and stencils of human hands and weapons (Mathews, 1893, pp. 353–6, Pl. xix, map; 1896, pp. 90–1, Pl. I, fig. 1; McCarthy, 1944, p. 184). Nine *Bondi* points were the only implements in the shallow deposit obtained by Mr. F. A. Davidson and presented to the Australian Museum.

9. *Putty.* Rock-shelter containing stencils of human hands. A test-trench dug by Mr. F. A. Davidson yielded 22 *Bondi* points, 1 thick microlithic segment, 3 oblique trimmed blades, 2 narrow re-directing flakes.

10. *Wolgan Gap.* A large rock-shelter containing stencils of human hands and weapons, and other drawings. Test-trenches dug in various parts of the shallow deposit by Professors J. L. Shellshear and A. A. Abbie, and the author, yielded 2 bi-polar flake fabricators, 8 *Bondi* points, 1 thick microlithic segment.

11. *Menai Creek, Heathcote.* A test-trench dug by Mr. W. H. P. Kinsela yielded 16 *Bondi* points, 2 *Elouera*, 8 flake fabricators, 2 side, 1 side and end, and 1 double side scrapers, and 2 microlithic end scrapers. A fish-hook file was found near the surface, and an edge-ground axe blade was picked up on the surface.

12. *Singleton.* Geometrical microliths, *Bondi* points, and *Elouera* adze-flakes abundant in an industry found on high terraces of the Hunter River (McCarthy and Davidson, 1943).

A perusal of the above list of sites will reveal that the Bondaian culture is associated with raw-ochre drawings, paintings and stencils in five rock-shelters. Furthermore, in the Milbrodale rock-shelter (No. 8) the figure of the culture-hero, approximately 3 metres high and 5 metres across the hands, is of the All-father type so important in the religion of south-east Australia; it is possible, therefore, that this All-father belief belongs to the Bondaian culture period. It is necessary to draw attention to the fact that the *Bondi* point has not yet been found in association with the outline rock engravings in the central coastal area of New South Wales, but future excavations or other field-work may reveal such an association and so increase the antiquity of this interesting art cult.

Eloueran Culture.

The following rock-shelters and other sites have yielded implements of the Eloueran culture period.

1. *Lapstone Creek.* A small rock-shelter higher up Lapstone Creek than the cave dealt with in this study. A mixture of Bondaian and Eloueran implements (McCarthy, 1934 and 1943, p. 150).

2. *North Harbour, Port Jackson.* A rock-shelter containing human hand stencils, a midden on the shore, and a group of rock engravings 110 metres away. The cave yielded a skeleton covered with a large stone, split kangaroo bones, and a siliceous flake. The short midden yielded two skeletons each covered with large stones, split kangaroo bones, a fish-hook file and a siliceous flake (David and Etheridge, 1889).

3. *Long Bay.* A skeleton, together with an edge-ground *Bulga*-knife, and a flake, from beneath a pumice bed covered by sand (David and Etheridge, 1889).

4. *Brown's Bay, Pittwater.* A deposit from 30 to 110 cm. deep in a rock-shelter yielded 6 split-pebbles, 2 worked pebbles, 56 normal flake and blade implements, 1 *elouera* adze-flake, 1 edge-ground *Bulga*-knife, 1 nucleus, 1 hammerstone, 1 rasp, and 2 pieces of red ochre (Kennedy, 1934, and McCarthy, 1943, p. 150).

5. *Lake Burrill.* A deposit about 110 cm. deep in a rock-shelter, excavated by the Anthropological Society of New South Wales, yielded 16 nuclei, 3 utilized nuclei, 1 nucleus with alternate platforms, 11 blocks, 2 slices, 3 uniface pebble implements, 17 *elouera* adze-flakes, 95 scrapers, 35 knives and saws, 6 burinates, 4 piercers, 18 bi-polar flake fabricators, 7 hammerstones, 1 anvil-stone, and 1 edge-ground axe (Thorpe, 1931-32, and McCarthy, 1943*a*, p. 151).

6. *North-West Arm, Port Hacking.* A shell midden up to 110 cm. deep yielded skeletons, a fish-hook file, 3 bone awls, and 1 scraper.

7. *Woolwich, Port Jackson.* A rock-shelter yielded a fish-hook file, 2 *elouera* adze-flakes, 1 scraper and several bone awls.

8. *Middle Harbour.* A rock-shelter containing human hand stencils yielded 1 human skull, 1 cranium, 2 lower jaws, 8 edge-ground axes, and 1 "nose ornament" (probably a fish-hook file). (Bray, 1888.)

The material from the above sites now makes it possible to establish the association of some of the important culture elements of eastern New South Wales with the Eloueran culture, which is a much richer one than the earlier Bondaian culture. In addition to the edge-ground technique, the Eloueran culture embraces outline rock engravings, stone cairns, fish-hooks and files. It inherited the rock drawings, paintings and stencils from the Bondaian culture. Burial by covering the body with large flat stones is typical of the above Eloueran period sites Nos. 2 and 3, but insufficient data is as yet available on the disposal of the dead to differentiate the various methods associated with the two cultures.

The reasons for this grouping of traits can be stated briefly. Axe-grinding grooves occur so frequently with the outline rock engravings in the Sydney-Hawkesbury district that there can be no doubt that this art flourished during the Eloueran period. Moreover, stone cairns also occur with some of these groups of rock engravings, as at Somersby and at two sites in Kuring-gai Chase. In addition in a rock-shelter at Brisbane Water engravings and dry pigment drawings occur together, and edge-ground axes were dug out of a rock-shelter, No. 8, at Middle Harbour, which contained human hand stencils. In regard to the fish-hook technique I suggested (1940B, p. 269; 1943*a*, p. 151) that it had diffused down the east coast of Australia, and the frequent occurrence of fish-hook files with the edge-ground axes and *Bulga*-knives now makes it possible to ally this diffusion with the Eloueran period; early accounts of the aborigines of Port Jackson and Botany Bay record the making and use of fish-hooks by the aborigines. It is, of course, particularly important to note that the Long Bay pumice bed skeleton, and the axes recovered from the ancient land surface at Shea's Creek, Botany, in association with dugong remains (Etheridge, David and Grimshaw, 1896), can now be dated as Eloueran period. It is interesting to note that Browne (1945, p. xxiii) is of the opinion that the Shea's Creek find of dugong bones and axe-heads indicates human occupation before the Pleistocene quite came to an end, and the latter event took place, he thinks (*op. cit.*, p. vi), some 9,000 years ago. According to this statement, therefore, the Bondaian culture period is late Pleistocene in age and the Eloueran existed throughout the Recent period. This conclusion is supported by the cultural evidence of the age of the ground-edge technique, which has been shown (McCarthy, 1940, pp. 40–42) to belong to the Hoabinhein II culture of the mesolithic period in south-east Asia.

Surface Sites in South-Eastern Australia.

In previous papers (McCarthy, 1943, A–B; 1947) I have shown that the Eloueran and Bondaian cultures are intermingled on east coast shell-middens as far north as Tallow Beach, south to about the Victorian border, and inland to the tablelands. It is evident, of course, that the same cultural changes took place on these sites as in the Lapstone Creek rock-shelter. In other words, the transitional methods of working stone were not changed, but some types of flake and blade implements produced were abandoned and others given more importance. In addition, traits such as the edge-ground technique and fish-hook making diffused southward and were embodied in the culture of the natives, but there is no evidence to indicate that they were brought by a new wave of aborigines from the north.

The geometrical microliths present a problem upon which much more evidence from excavations is necessary before an explanation can be given for their somewhat erratic occurrence. They occur from south-east South Australia right across to the eastern coast of Victoria in enormous numbers, and are comparatively scarce in eastern New South Wales excepting at Singleton on open workshops (McCarthy and Davidson, 1943) where they are abundant, together with *Bondi* points, on Bondaian period sites restricted to a high terrace of the Hunter river. Thus the almost complete absence of the triangles, trapezes and segments in the rock-shelter deposits of eastern New South Wales containing Bondaian culture material is in keeping with their scarcity on most of the surface sites, and it is a cultural variation of some importance. In any case, the small number recovered from these deposits indicates that the geometrical microliths belong to the Bondaian culture, and throughout Victoria and South Australia they are found in association with the *Bondi* point. The explanation appears to be that the Lapstone Creek rock-shelter deposit represents an early phase of the Bondaian culture, and that the full development of the geometrical microliths was a subsequent event. The Singleton site would thus represent a later phase of the Bondaian culture.

The wider relationships of the Bondaian and Eloueran cultures with those elsewhere in Australia, and in other countries, will be fully discussed in a forthcoming paper.

Hafting of the Elouera and Edge-Ground Axes.

Elouera adze-flake. This implement has hitherto been described as a scraper-knife (McCarthy, 1946, p. 27) with the reservation that it might be an adze. Hunter (1793, p. 452) stated that on the Hawkesbury River, in the vicinity of Richmond, the spear-thrower "had a piece of hard stone fixed in gum instead of the shell commonly used on the sea-coast; it is with these stones, which they bring to a very sharp edge, that the natives make their spears". Bradley (October, 1788) said that the adze in the Sydney area was made of the same kind of stone, and was secured to a stick in the same manner as the axe-heads; he probably meant that both implements were hafted with the aid of gum-cement. It appears obvious from the analyses given of the Eloueran culture in this and other papers that the only implement to which the statements of Hunter and Bradley could refer is the *elouera*, and I now propose that it be termed an adze-flake in the future.

Edge-ground axe. Hunter (1793, p. 445) stated that a man on the western bank of the Hawkesbury River in the vicinity of Richmond Hill carried a stone axe, and there are many other references, which need not be quoted, to their use by the natives met by the explorers of the First Fleet in this and the Sydney district generally. They also pointed out that the natives used the axes to cut toe-holds when climbing trees, to cut and wedge off sheets of bark from the trunks of trees for making canoes and shields.

to make holes for burning-out or securing opossums, and as a general working tool. Illustrations in existence demonstrate that the axes were hafted in a pliable withy, gummed where it passed around the axe-head, and tied at various points along the handle. Bradley (October, 1788) stated that they were secured with gum and lashing to a stick two feet long in the Port Jackson area.

Acknowledgements. I should like to express my sincere thanks to Mr. G. E. Bunyan, of Emu Plains, who found the Lapstone Creek rock-shelter deposit, to whom I am indebted for the opportunity of examining his collection of surface implements from the district and also for information about the various relics in the district described in this paper. My thanks are also due to Mr. G. Binsted for his drawings of figures 4 to 91.

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EXPLANATION OF PLATES.

Plate i.

Fig. 95 (top left).—The rock-shelter on Lapstone Creek.

Fig. 96 (top right).—The deposit behind the fireplace in process of excavation.

Fig. 97 (bottom left).—View taken from inside the rock-shelter showing the large slab of stone at the back of the fireplace and the rocky platform outside.

Fig. 98 (bottom right).—View taken from the eastern end showing the fireplace and the trench through the shallow deposit on the rocky platform outside the rock-shelter.

Photos, F. D. McCarthy.

Plate ii.

Fig. 99 (top).—View southward up the Nepean River at Castlereagh, showing rocks on left bearing axe-grinding grooves, and the Black's Falls on the pebble bar in the middle distance.

Fig. 100 (middle).—Some of the human hand stencils in the rock-shelter in the bed of the creek (see Fig. 1).

Fig. 101 (bottom).—One of the large and deep grooves is shown in the middle of this photograph, and a series of other grinding grooves on the rock in the lower right-hand corner.

Photos, late C. C. Towle.

Plate iii.

Fig. 102.—Two large series of grinding grooves on some of the numerous rocks bearing them on the river bank at Castlereagh.

Photos, late C. C. Towle.

Eloueran industry implements.

Fig. 103.—Trimmed pebble axe blank.

Fig. 104.—Biface coroid edge-ground axe.

Fig. 105.—Pebble edge-ground axe with battered butt.

Fig. 106.—Pebble fabricator with biface edge.

Fig. 107.—Side-blow slice from a pebble trimmed into a blank ready for grinding the blade to form a *Bulga*-knife.

Fig. 108.—Edge-ground *Bulga*-knife.

Fig. 109.—*Windang* uniface pebble axe.

Fig. 110.—*Worimi* cleaver, showing trimmed back.

Photo, G. C. Clutton.

Plate iv.

Implements from Surface Workshops.

Fig. 111.—*Windang* uniface pebble axe, trimmed and ground on one facet only. Castlereagh.

Fig. 112.—Pebble edge-ground axe. Emu Plains.

Fig. 113.—Pebble edge-ground axe, trimmed and used as a hammer on one lateral margin and butt. Emu Plains.

Fig. 114.—Pebble edge-ground axe, used as a hammer on one lateral margin and butt, with a deep anvil-pit on both surfaces. Emu Plains.

Fig. 115.—Split-pebble slice. Emu Plains.

Fig. 116.—Uniface pebble implement with trimmed lateral margin. Castlereagh.

Fig. 117.—Uniface pebble implement with trimmed concave lateral margin and end. Emu Plains.

Fig. 118.—Uniface pebble implement trimmed all over one surface, and probably an axe-blank. Emu Plains.

Fig. 119.—Pebble axe-blank trimmed on one side at one end. Castlereagh.

Fig. 120.—Large uniface pebble implement trimmed on one end, and used as a hammer on the butt. Castlereagh.

Fig. 121.—Uniface pebble axe-blank trimmed on both lateral margins and one end. Castlereagh.

Fig. 122.—*Windang* uniface pebble axe, ground on both facets of blade and along upper surface only on both lateral margins. Used as a hammer on the butt, and as an anvil on one surface. Castlereagh.

Fig. 123.—*Windang* uniface pebble axe reverse-trimmed on lateral margins, ground on both facets of the blade, and used as a hammer on the butt. Castlereagh.

Fig. 124.—*Windang* uniface pebble axe, trimmed round butt end, and showing flaking done prior to grinding the blade. Castlereagh.

Fig. 125.—Pecked and grooved axe-head. Castlereagh.

Fig. 126.—*Windang* uniface pebble axe trimmed all over one surface, ground on both facets of blade, used as a hammer on the butt and as an anvil on both surfaces. Emu Plains.

Fig. 127.—Trimmed pebble edge-ground axe-head.

Fig. 128.—Pebble percussion stone used as a hammer around edge, with a deep anvil-pit on both surfaces. Castlereagh.

Fig. 129.—Pebble percussion stone used as a hammer along lateral margins, with trenches of anvil-pits on both surfaces. Emu Plains.

Fig. 130.—Trimmed biface coroid fabricator. Castlereagh.

Fig. 131.—Pecked axe-head, with a ground blade at each end, round transverse section. One of the blades has been hammered to a flat face. Emu Plains.

NEW SOUTH WALES MARGINELLIDAE.

By CHARLES F. LASERON.
Honorary Correspondent, Australian Museum.

(Plates V–VI.)

Marginella is common in, but not confined to Australian seas. About a thousand species have been described, many from the tropics, but the majority from temperate waters of the southern hemisphere. In Australia, particularly in the south, they form a conspicuous element of the marine molluscan fauna.

The most complete list of Australian species is that published by Bernard C. Cotton,[1] of the South Australian Museum. He lists 92 species, including several that are new. Fifteen more new species are now added from New South Wales, and no doubt a number still remain to be described, particularly from Western Australia, north Australia and Queensland. It is interesting to note that most of the described species have a fairly wide geographical distribution, and many are common to several zoo-geographical provinces. As is to be expected, there is a somewhat closer relationship between New South Wales species with those of Tasmania, than with those of the Flindersian fauna (Victoria, South Australia and the southern portion of Western Australia), but many species are common to all three areas. It is very probable that *Marginella*, like *Cypraea*, has a free swimming larval stage of some length, and is thus able to migrate more rapidly and widely than most other molluscs.

The number of species occurring in New South Wales is probably not yet completely known, as no doubt more will be found, particularly on the continental shelf. Hedley's "Check List of New South Wales Mollusca", published in 1917, allowed 27 species. In the present paper 45 species and three varieties are dealt with, and four of Hedley's list are regarded as doubtful. Of these, 23, or practically one-half, occur in Tasmania, 19 in Victoria, while only 10 are found in South Australia. The total number of species in each of these areas is about 50, Australian tropical species are fewer in number, and practically none of them are common with species from the colder waters of the south.

Practically nothing is known of the life history of *Marginella*, and the animals of only two Australian species have so far been described. In 1916, Hedley described both the animal and radula of *M. mustellina* Angas,[2] and in 1944 Cotton described the animal of his own species, *M. weedingi*.[3] As the former inhabits the reefs in shallow water, and the latter is a deep-water dredged species, it is interesting to note that the general characters of each animal are much the same. There is the same long, narrow foot, blunt head, prominent tentacles with eyes at the outer base, long siphon and mantles at either side covering the shell. In *M. mustellina* the mantles are papillate, while in *weedingi* they are covered with small divided processes. These descriptions are very close to that of the animal of the Cypraeidae, with which family Marginellidae is evidently closely related.

M. mustellina and *M. angasi* are inhabitants of the reef, and *M. nympha* is common on seaweed, but most species are essentially sand living, and are found from the edge of the beach to very deep water beyond the continental shelf. It may be noted that the animal is extremely active, a characteristic of many sand-living forms, particularly the carnivora.

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[1] Cotton.—*South Australian Naturalist*, Vol. 22, No. 4, Nov. 30, 1944.
[2] Hedley.—*Proc. Linn. Soc. N.S.W.*, xli, 4, 1916, p. 709, Pl. I, figs. 30, 31.
[3] Cotton.—*Loc. cit.*, p. 16.

Species are rather restricted to depth zones, and those living on the open beaches just below low water are seldom found in deeper water. Depths from about 5 to 20 fathoms have characteristic species, though it was noticed in Jervis Bay that species from five fathoms were quite different from those from 15 fathoms, even though the nature of the bottom was identical. Again, in 20 to 60 fathoms, on the continental shelf, another distinctive group of species is to be found; while from the few really deep water dredgings, still further species have been found.

One genus or many? When the number of species in any genus is very large, many modern systematists have advocated its division, largely on the grounds of convenience. The view is held here that unless very definite generic characters can be given the procedure is not only unscientific but defeats its own end by creating a confused and unwieldy nomenclature.

Marginella is a case in point. At first sight it would seem to be divisible into fairly natural groups, but there are too many intermediate species to make these groups hard and fast and to warrant new generic names. Cotton in his paper has used such groups as a guide to the student of local species, and this is all that is necessary, at least until our knowledge of their anatomy and life history is much further advanced. He uses seven groups, designated from A to G, based mainly on the length of spire, general form, and presence or absence of colour bands. This is a convenient subdivision as far as it goes, but, as he himself recognizes, not definite enough for generic separation. A more important character, which may have genetic value, is the number of plications on the columella. What does seem a natural group is a series of small shells, centred around *M. angasi*, with the columella multi-plicate. In most species the number of plications is four, and species with six or more, occupying the greater length of the inner margin, stand out from the others. Some species have less than four plications, but in these, rudimentary folds are often present right inside the aperture, and invisible from in front. Another group which may later justify generic separation is that about *M. ovulum*, in which the shell is entirely involute, and the spire invisible externally.

I have not followed Cotton's grouping in this paper, as the smaller number of species dealt with does not necessitate it. The species nevertheless are arranged so that, as far as possible, allied forms are kept together. They are all figured, and a glance at the plates will show the gradual transition from one extreme form to another. Fortunately in this controversial subject there is one point which seems reasonably sure. Whatever future classification is decided on, each species dealt with here is undoubtedly a *Marginella*.

Acknowledgements.—Much of the credit for the collection of material for this and future papers goes to my son John, who has been my companion in all collecting trips, and whose keen eye has brought to light many finds. Mr. T. Iredale, formerly Conchologist of the Australian Museum, has continually helped me from the storehouse of his great knowledge and experience. To Miss J. Allan, the present Conchologist, my thanks are particularly due. It was Miss Allan who suggested that I should write up the material collected in the last twenty years; she has looked up references for me, made suggestions, and finally read through and checked the paper itself.

Types.—All types, as well as specimens illustrated, have been presented to the Australian Museum, where they will be available for future reference.

REVIEW OF SPECIES.

References.

Hedley, 798.—The number is that in Hedley's Check List of N.S.W. Mollusca, Supplement to *Journ. Roy. Soc. N.S.W.*, Vol. LI, 1917.

May, 695.—Number in May's Check List of the Mollusca of Tasmania, Govt. Printer, Hobart, 1921.

Marginella turbinata Sowerby. (Pl. v, fig. 1.)

Hedley 798.

This is one of our commonest species, mostly found on the outer beaches. It apparently lives in the sand below low tide, but ranges into deeper water. The ribbing on the shoulder is characteristic, but varies somewhat, as some specimens are practically smooth.

Localities.—Fifteen fm. between Heads, Port Jackson, the specimen figured 9·5 mm. in length; Cronulla and other beaches; 14 fm. off Long Reef; dredged in Pittwater; 30–35 fm. off Crookhaven.

Marginella turbinata var. *pusilla*, var. nov. (Pl. v, fig. 2.)

In the Roy Bell Collection in the Australian Museum are specimens from 60 fathoms, Twofold Bay, indistinguishable from *turbinata*, except that they are much smaller, the specimen figured being only 6·5 mm. in length, and somewhat broader. The ribbing is also a little more pronounced. Specimens of *turbinata* from 30–35 fathoms off Crookhaven are somewhat intermediate in character, and it seems that this species in deeper water tends to become smaller and broader, denoting racial but not specific difference. From South Australia, Cotton has described *M. pattisoni* from shallow water, a species which greatly resembles this variety. Further collecting from intermediate localities may link *pattisoni* with *turbinata*, which is a variable species, and which may possibly be divisible into many local races.

Marginella olivella Reeve. (Pl. v, fig. 3.)

Hedley 790.

Localities.—Dredged North Harbour, the specimen figured 6·5 mm. in length. This specimen is yellowish with a white base, and a white band near the top of the whorl. Pure white specimens were abundant associated with *infelix* in 6–9 fathoms, Sow and Pigs Reef, and it was also taken alive in 15 fathoms, Jervis Bay. It also occurs with *infelix* and other species on the outer beaches.

Some confusion has in the past existed as to the exact identity of *olivella* and *infelix*. Hedley allowed both species in his check list, but May synonymized *infelix* with *olivella*. May previously had synonymized a species of his own, *procella*, under *infelix*. After examining long series from several localities, both in our own and the Australian Museum collections, I am satisfied that two forms exist, a narrow and a broad one; the broad form rounded, the narrow with nearly straight sides. The narrow form also has a squarer shoulder at the top of the aperture, a feature more apparent from the back of the shell. From Reeve's original description, and from specimens in the Australian Museum compared with the type, the narrow form is the true *olivella*. I think their association together is somewhat accidental, as live specimens of *olivella* in deeper water are by themselves, while *infelix* is particularly abundant on the beaches, with *olivella* only occasionally present.

Marginella infelix Jousseaume. (Pl. v, fig. 4.)

Hedley 791.

Localities.—Six to nine fm., Sow and Pigs Reef, the specimen figured 7 mm. in length. Also common on outer beaches, where it evidently lives just below low tide.

The differences between this and *olivella* have already been discussed, and though Hedley labelled specimens in the Museum as *olivella*, var. *infelix*, I think the differences are constant enough to be considered specific.

Marginella inconspicua Sowerby. (Pl. v, fig. 5.)

Hedley 780.

This is not a common beach shell, but is found abundantly in moderately deep water, from 5 to 20 fathoms, on sandy or muddy sand bottoms.

Localities.—Dredged in North Harbour, Port Jackson, 6 fathoms, the figured specimen 5·5 mm. in length. The shell is ivory coloured with a pale yellow band near the top of the body whorl. Specimens from 5 fathoms, Jervis Bay, alive on a pure sand bottom, are a little broader, dark grey from the animal within, and with a light coloured subsutural band. Also obtained from 14 fathoms off Long Reef, and from 20 to 35 fathoms off Crookhaven.

Marginella schoutanica May. (Pl. v, fig. 6.)

May 688.

A number of specimens, from 5 to 25 fathoms, Twofold Bay, were sorted from the Roy Bell Collection, and agree very well with May's *schoutanica.* This is a new record for New South Wales. The specimen figured is 7·5 mm. in length. This species is like *inconspicua,* but is larger, broader, and has a slightly different contour. It is ivory coloured and highly polished, with a tendency to develop faint plications on the shoulder.

Marginella punicea, sp. nov. (Pl. v, fig. 7.)

Shell regularly ovate, white when dead, but when taken alive, a delicate mauve pink, base and spire white. Animal reddish. Spire of moderate height, of three whorls, pointed. Shoulders sloping, regularly curved. Aperture long, of moderate width, widening slightly anteriorly. Outer margin with sloping shoulder, joined to the body whorl above its maximum width, but well below the suture. Canal broad, the outer margin rounded and expanding. External varix slight. The outer margin thickened and microscopically dentate. Plications on columella four, oblique, slight, and within the anterior fourth of the aperture. Length 8·5 mm.

Localities.—Fifteen fathoms, Jervis Bay (type), four specimens alive on pure sand bottom; 6–9 fathoms, Sow and Pigs Reef, Port Jackson, one specimen.

This is a well marked species, distinguished by the regularly rounded body whorl, with complete absence of any shoulder.

Marginella pipire, sp. nov. (Pl. v, fig. 8.)

Shell small, narrowly ovate, narrowed anteriorly, white. Spire of three whorls, of moderate length. Body whorl regularly curved, not shouldered. Aperture long, narrow above, widening anteriorly, joining the body whorl just above its maximum curvature, but below the suture, and with a distinct shoulder. Outer margin without an external varix, but inflected and thickened. Canal narrow and rounded. Columella plications four strong, oblique and of equal size, and within about half the total length of the aperture. Length, 3·5 mm.

Locality.—Sixty fathoms, off Twofold Bay (type), Roy Bell Collection.

This is the species identified by Mr. J. R. le B. Tomlin as *caducocincta,* and recorded by Iredale as a new record for New South Wales.[4] It is, however, definitely not *caducocincta,* being much smaller and of an entirely different shape. Nor will it fit with any other Australian species. There is no outstanding characteristic to serve as a ready recognition mark.

Marginella strangei Angas. (Pl. v, fig. 9.)

Hedley 795.

Localities.—Eight to ten fathoms, off Point Halliday, the specimen figured 4·5 mm.; 6–9 fathoms, Sow and Pigs Reef; outer beaches at Port Hacking and Crookhaven Heads.

It has been difficult to decide what is exactly Angas's species. In the Australian Museum is a tube labelled *strangei* and "compared with the type in London", but as there are more than one species in the tube, this does not help us. The original figure is rather small, and the description not quite full enough to make identification beyond doubt, but this is the only species examined which reasonably fits. Additional points which might be noted are that the aperture is high and joins the body whorl right at the suture or a little above, and that the four columellar plaits are within the lower two-fifths of the aperture; they are oblique, and the upper one is smaller, and barely visible from in front. From the beaches some specimens are a little smaller, just less than 4 mm., but are otherwise indistinguishable.

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[4] *Proc. Linn. Soc. N.S.W.,* xlix, 1924, p. 261.

***Marginella frequens*, sp. nov. (Pl. v, fig. 10.)**

Shell small, ovate, white. Spire of three whorls, short, body whorl regularly curved with very slight shoulder. Aperture long, fairly wide and only slightly wider at the posterior extremity, joined to the body whorl right at the suture, and with a rounded but pronounced shoulder. Outer margin with a slight varix, but inflected, the edge smooth and not denticulate. Canal rounded and not expanded. Columellar plications four, oblique, strong, the lower three sub-equal, the posterior one separate, and more within the aperture, the whole within about half the length of the aperture. Length, 3·2 mm.

Localities.—Thirty to fifty fathoms off Sydney, common (type); 30–35 fathoms off Crookhaven, common.

This is apparently a common and widely distributed species on the continental shelf, and it is surprising that it has escaped notice. It is certainly not any of the species recorded by the "Thetis" and other expeditions. The shouldered aperture, and its junction right at the suture, are good recognition points. Its nearest relation is *M. strangei*, of which it may be the deep water representative. It is, however, much smaller, is white and glassy when alive instead of yellowish, the upper plication on the columella is more widely separate and the whole lie higher up than in *strangei*.

Marginella binivitta, sp. nov. (Pl. v, fig. 11.)

Shell oval, white and translucent, with two pale yellow bands on the body whorl, which are apt to fade fairly rapidly. Spire very short and small, of two or three whorls. Body whorl rounded with a very slight shoulder. Aperture as long as the shell, of moderate width above but broadening below, its junction almost at the apex, the rounded shoulder level with or even above the apex. Outer margin rounded, with a slight varix, narrowly inflected, the edge plain with no trace of denticulation. Canal of moderate width, rounded. Columella plications four, the lower two well marked and oblique, the third much smaller. The fourth plication is well above the third and is very small, almost obsolete, so that at first sight the shell seems tri-plicate. The four plications are within the lower two-fifths of the aperture. Length, 6·5 mm.

Localities.—Fifteen fathoms, Jervis Bay (type), several specimens from a pure sand bottom; 30–35 fathoms, off Crookhaven, abundant in sandy mud.

This approaches close to *M. altilabra* May, but has a still higher and more expanded aperture. It is also like the species May records from Tasmania as *agapeta* Watson, but which has but three plications. Incidentally this is nothing like the original figure of *agapeta*, the Tasmanian record of which is exceedingly doubtful. The nearest relation, however, is *olivella*, from which it is distinguished by the very high aperture and more tapering anterior extremity.

Marginella victoriae Gatliff and Gabriel. (Pl. v, fig. 12.)

Hedley 799.

Locality.—Six to nine fathoms, Sow and Pigs Reef, Port Jackson, the specimen figured 4·5 mm. in length; also dredged in Pittwater, and from 15 fathoms off the Clarence River.

This is a common species in Harbour dredgings, and can be recognized by the dentate edge of the outer margin. Specimens in the Museum Collection from Middle Harbour are labelled as "confirmed by Gabriel as *M. victoriae*", and our specimens are the same as these.

Marginella sinuata, sp. nov. (Pl. v, fig. 13.)

Shell small, white, ovate. Spire short and blunt, 3 or 4 whorls. Body whorl rounded with a slight shoulder. Aperture rather wide, joining the body whorl at the suture. Outer margin with a wide and prominent external varix, thickened and widely inflected, the inflected platform with a prominent sinus at its posterior end. Canal rounded. Columella plications strong, the lower two moderately oblique, the upper two nearly transverse, the upper somewhat separate from the others, and all occupying fully one-half of the length of the aperture. Length, 3·3 mm.

Locality.—Eight to ten fathoms off Point Halliday, in pure sandy bottom, common.

This is another of what might be termed the *strangei* group of *Marginella*, and approaches closest to *frequens* (Fig. 10), but differs chiefly by the stronger and more widely placed columella plications, and by the sinus in the inner edge of the outer margin.

Marginella subbulbosa Tate. (Pl. v, fig. 14.)

Hedley 796.

Localities.—Beach at Huskisson, Jervis Bay, the specimen figured 3·6 mm. in length; also on outer beaches at Manly, Crookhaven Heads and other localities.

This is a well-marked species, and can be easily recognized by the denticulate edge of the margin, and by being strongly lirate within the aperture. Originally described from South Australia with four columella plications, and figured from Tasmania with the same number, it is interesting to note that there are actually six, but the upper two can be easily overlooked, as they are very small and generally quite invisible from in front. This suggests relationship with *M. angasi*, and other multi-plicate species.

Since writing the above Miss Allan has checked specimens in the Museum from both South Australia and Tasmania, and finds the extra plications present in both cases; so this character is persistent throughout the entire range, and further confirms the identification of the New South Wales species.

Marginella sinapi, sp. nov. (Pl. v, fig. 15.)

Shell small, elongate-ovate, yellow and translucent. Spire rather long, of two or three whorls. Body whorl long and rather narrow, with practically no shoulder. Aperture joining the body whorl at its maximum diameter, and well below the suture, the shoulder sloping. Outer margin with slight external varix, but strongly inflected, the edge plain with no denticulation. Canal rounded. Columella plications four, strong, the lower two oblique, the upper two separate and more transverse, the whole occupying one-half the length of the aperture. Length, 2·5 mm.

Locality.—Six to nine fathoms, Sow and Pigs Reef (type), not uncommon; also on the ocean beaches at Manly and Port Stephens. Specimens in the Australian Museum from Broughton Island are labelled as "Undescribed species", and it was obviously Hedley's intention to name this at some future date. It is a very distinctive little species, not readily to be confused with any other on the coast.

Marginella parsobrina sp. nov. (Fig. 1.)

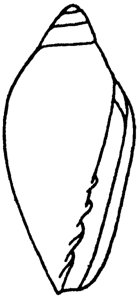

Figure 1.

Shell small, broadly spindle shaped, white. Spire rather long, blunt, of three whorls. Body whorl rounded, widest medially, narrowed posteriorly, shoulder rounded. Aperture narrow, of even width throughout, comparatively short. Outer margin joining the body spire at the maximum width, well below the suture, shoulder sloping, nearly continuous with the line of the spire, outer varix strong and wide, the margin edge thick and evenly inflected, not denticulate. Canal narrow and rounded. Columella plications four, occupying about half the length of the aperture, strong, the lower two very oblique, the upper two more transverse. Length, 4 mm.

Locality.—Thirty to thirty-five fathoms off Crookhaven.

This species was sorted from a parcel of mud and sand which came to hand from my friend Mr. T. Nielsen, of Crookhaven, after the main part of this paper had been written, and so could not be included in the prepared plates. It is quite a distinctive species, resembling in outline *sinapi* and *translucida*, between which species it is intermediate in size. The narrow, sloping shoulder of the aperture is a good recognition character.

Marginella translucida Sowerby. (Pl. v, fig. 16.)

Hedley 797.

Localities.—Dredged, 6 fathoms, North Harbour, Port Jackson, the specimen figured 5·8 mm. in length. Specimens from here are yellow with a white sub-sutural band, but fading to a dead white. Also alive from 5 fathoms, Jervis Bay, on a pure sandy bottom. Common on the outer beaches in many localities, Port Stephens, Crookhaven Heads, *et cetera.*

Marginella humerica, sp. nov. (Pl. v, fig. 17.)

Shell large, solid, broadly ovate, yellowish. Spire rather long, of three whorls. Body whorl with fairly pronounced shoulder. Aperture comparatively wide, joining the body whorl at the suture, with wide rounded shoulder. Outer margin thick, with prominent external varix, strongly inflected, edge not denticulate. Canal broad and rounded. Plications on columella four, strong, oblique, occupying about two-fifths of the length of the aperture. Length, 8·5 mm.

Locality.—Twelve fathoms off Tacking Point, Port Macquarie. Specimen in Australian Museum, collected by Mr. J. Brazier. (Type.)

This species is close to *translucida*, but is much larger, the aperture is comparatively longer, and its shoulder more pronounced.

Marginella freycineti May. (Pl. v, fig. 18.)

May 661.

Locality.—Thirty to fifty fathoms off Sydney, the specimen figured 1·8 mm. in length. This is a minute, colourless, glassy shell, and may be recognized by its three columella plaits and high aperture. It agrees very well with May's *freycineti*, which is a common Tasmanian deep-water shell, and thus is a new record for New South Wales.

A broader variety, but otherwise indistinguishable, is from 30–35 fathoms off Crookhaven, length 2 mm. (Pl. I, fig. 19). A longer series is necessary to determine whether the differences are sufficient to be considered specific.

Marginella cratericula Tate and May. (Pl. v, fig. 20.)

Hedley 778.

Locality.—Sixty fathoms off Twofold Bay (Roy Bell Collection), the specimen figured 2 mm. in length. This is a minute, glassy shell with two columellar plaits, and can be readily recognized by the hollowed-out spire.

Marginella stilla Hedley. (Plate v, fig. 21.)

Hedley 794.

Locality.—Twenty-five to sixty fathoms off Bateman's Bay, the specimen figured 5 mm. in length.

This is a fairly common deep-water species, and may be considered as typical of the continental shelf, from which Hedley records it from many localities. The strongly denticulate outer margin is a good recognition character.

Marginella quinqueplicata, sp. nov. (Pl. v, fig. 22.)

Shell large, broadly ovate, white and solid. Spire short and blunt, of four whorls. Body whorl with a pronounced shoulder, tapering anteriorly. Aperture fairly broad, joining the body whorl below the suture. Outer margin with rounded, sloping shoulder, thick, external varix not strong, but widely inflected, the edge strongly dentate and transversely striated. Canal broad, truncate and expanded. Columella plaits five, oblique, decreasing regularly in size posteriorly, the upper two faint, the last barely visible from in front, the whole within nearly half the length of the aperture. Length, 9 mm.

Locality.—Five fathoms, Twofold Bay (Roy Bell Collection).

This is a prominent and well-marked species, allied perhaps to *turbinata*. It is the only species I have seen with five columella plaits, and this and its large size make it readily recognizable.

Marginella mustellina Angas. (Pl. v, fig. 23.)

Hedley 787.

Locality.—Alive under rocks, North Harbour, Port Jackson, the specimen figured 6·5 mm. in length.

This is a common shallow-water species right along the coast, and is one of the few Marginellas which inhabit the reefs. Its rich mottled brown colouring with two white bands makes it an easily recognizable shell.

Marginella haswelli, sp. nov. (Pl. v, fig. 24.)

Shell of moderate size, elongate, regularly ovate, colour of dead specimens very pale brown, with two broad white bands. Spire of two whorls, the apical small, the second inflated. Body whorl long and narrow. Aperture long, widening anteriorly, joining the body whorl just below the suture. Outer margin with narrow sloping shoulder, with strong external varix, narrowly inflected, the edge finely denticulate. Canal moderately wide, rounded. Columella plaits four, oblique, the lower pair stronger, the whole occupying about one-fourth of the length of the aperture. Length, 8 mm.

Locality.—Eighty fathoms, 22 miles east of Narrabeen, three specimens (including the type) in the Museum Collection, presented by the late Professor Haswell.

In the Expedition of the H.M.C.S. "Miner", 1906, this species was determined as *M. stanislaus* Ten.-Woods, which has since been synonymized under *mustellina*. It is undoubtedly related to *mustellina*, of which it may be considered the deep-water representative, and from which it mainly differs in its much more elongate form, the narrower inflection of the margin, and the curious rather bulbous spire. Another related species is *M. occidua* Cotton from Western Australia, which is smaller, has a smooth outer margin and a more pronounced shoulder.

Marginella muscaria Lamarck. (Plate vi, fig. 25.)

Hedley 786.

Locality.—Ocean Beach, Cronulla, the specimen figured 14 mm. in length.

This is the largest as well as one of the commonest of our species, living in the sand just below low tide, and washed up in great numbers on all the outer beaches right along the coast.

Marginella johnstoni Petterd. (Pl. vi, fig. 47.)

Hedley 781.

Locality.—Ocean Beach, Cronulla, the specimen figured 9 mm. in length.

The species *johnstoni* is almost a replica of *muscaria*, with which it is commonly associated, and from which it can practically only be separated by its size. It lives in similar locations, but when *muscaria* is found within inlets, as in Crookhaven, *johnstoni* is generally absent.

Marginella tasmanica Ten.-Woods. (Pl. vi, fig. 26.)

May 691.

Localities.—Six to nine fathoms, Sow and Pigs Reef, Port Jackson; the specimen figured 9 mm. in length.

This was recorded from New South Wales by Iredale[5] from the Roy Bell Collection, and he remarks that it was common at Twofold Bay, below low tide mark associated with *muscaria*. Other specimens from Twofold Bay are labelled as from 5–25 fathoms.

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[5] Iredale.—*Proc. Linn. Soc. N.S.W.*, xlix, 1924, p. 261.

They are indistinguishable from the Port Jackson specimens. *Tasmanica* is closely allied to both *muscaria* and *johnstoni*, but can be distinguished by the longer spire and shorter aperture. It apparently generally inhabits somewhat deeper water.

Marginella kemblensis Hedley. (Plate vi, fig. 27.)

Hedley 782.

Locality.—Eighteen fathoms off North Head, the specimen figured 8 mm. in length. Also 14 fathoms off Long Reef. The type came from 63 fathoms off Port Kembla.

The long spire and dentate outer margin are good recognition points.

Marginella mayii Tate. (Plate vi, fig. 28.)

Hedley 784.

Locality.—The specimen figured was sorted from the Roy Bell Collection, from 60 fathoms off Twofold Bay, and is 13 mm. in length. Another specimen in the Australian Museum is from 9 fathoms, Port Jackson (C. Hedley).

This is apparently a rare species. It is allied to *kemblensis*, but differs in its larger size, different outline and longer aperture.

Marginella gabrieli May. (Pl. vi, fig. 29.)

May 663.

Localities.—Thirty to fifty fathoms off Sydney, the specimen figured 3·5 mm. in length, another 4 mm. Also 14 fathoms off Long Reef. Recorded from New South Wales by Iredale from the Roy Bell Collection from 60 fathoms off Twofold Bay.

This is a well-marked little species with long spire, the outer margin not dentate, and in fresh specimens three narrow, bright, orange bands on the body whorl. It is apparently a characteristic species of the continental shelf.

Marginella maugeana Hedley. (Plate vi, fig. 30.)

May 677.

Locality.—Fifteen fathoms, Jervis Bay, the specimen figured 5 mm. in length.

This is a new record for New South Wales. *Maugeana* is like *gabrieli*, but is larger, has no shoulder to the aperture, a different disposition of the columella plications, and one very broad and one narrow orange band on the body whorl.

Marginella cuneata, sp. nov. (Pl. vi, fig. 31.)

Shell of medium size, spindle shaped, the first two whorls glassy and colourless, the remainder ivory coloured with a colourless sub-sutural band. Spire long, of four whorls, the first dome shaped. Body whorl with shoulder well below suture, and median to the total length of shell, tapering below to give the regular spindle shape to the whole. Aperture about half the total length, with sloping shoulder continuing in the line of the whorls above, rather broad. Outer margin rounded, with a strong external varix, slightly inflected, the inner edge not dentate. Canal narrow and rounded. Columella plications four, strong, occupying more than half the length of the aperture, the lower pair the strongest, and very oblique, the upper pair more transverse. Length, 6 mm.

Locality.—Five to twenty fathoms, Twofold Bay, Roy Bell Collection (type).

Specimens in the Roy Bell Collection are labelled *M. denticns* May, and were identified by Tomlyn and recorded by Iredale as such on the N.S.W. list, but this species is certainly not *dentiens*. Its nearest relation seems to be *M. jaffa* Cotton, a South Australian species from 130–200 fathoms, which is smaller and has a tooth on the outer margin.

Marginella geminata Hedley. (Pl. vi, fig. 32.)

Hedley 779.

Locality.—Fifteen fathoms off Clarence River, length of specimen figured 4·6 mm. It has been recorded from many stations down to 75 fathoms on the continental shelf, and specimens are occasionally washed up on the outer beaches.

This is the largest of a group of species with a wing-like expansion of the aperture, but I do not think this character alone warrants generic separation. The New South

Wales specimens were originally known as *M. laevigata* Brazier, but Hedley separated them, restricting *laevigata* to North Queensland and Torres Strait.

Marginella ochracea Angas. (Pl. vi, fig. 33.)

Hedley 789.

Localities.—Alive under rocks, North Harbour, Port Jackson, the specimen figured 3 mm. in length, also alive in mussel beds from the same locality, and common on the beach at Manly, Port Stephens and other localities.

This is another of the few species which is typically a reef dweller, and the shore form may be taken as the true *ochracea.* From deeper water I have separated one species and one variety, but it is possible that others may still have to be named. An allied species, *M. borda* Cotton, from South Australia, is half as large again, and has a smooth outer lip.

Marginella ochracea Angas, var. *crescere,* var. nov. (Pl. vi, fig. 34.)

Shell with the general characters of *ochracea,* but much broader, and a more pronounced shoulder. Length 2·7 mm.

Locality.—Eight to ten fathoms off Point Halliday, common.

This may possibly be *M. gatliffi* May, a Tasmanian deep-water species, but I am not satisfied with the identification. *Gatliffi* was added to the New South Wales list by Iredale from the Roy Bell Collection, the locality given as 60 fathoms off Twofold Bay. Examination of these specimens shows them to have a typical *ochracea* shape, though a little larger, the length being 4 mm. In view of their habitat, they may possibly be different, but no difference in shell characters could be detected. I think that without further evidence their separation is not justified, and in the meantime *gatliffi* should not be admitted to the New South Wales list.

Marginella laeviplicata, sp. nov. (Pl. vi, fig. 35.)

Shell small, subtrigonal, yellow. Spire of moderate length, three whorls, rounded, sutures distinct. Body whorl inflated medially, tapering to a point anteriorly. Aperture comparatively wide, joining the body whorl well below the suture, the shoulder well expanded, almost square, outer margin sinuate, thickened and reflected, smooth. Canal narrow and rounded. Columella plications four, occupying about half the length of the aperture, the lower two of moderate strength and very oblique, the third small and more transverse, the upper one very small and nearly obsolete, generally invisible from in front. Length, 3·2 mm.

Locality.—Thirty to thirty-five fathoms off Crookhaven, common, on sandy to muddy bottom (type).

This is very like *M. ochracea,* with which it is evidently closely allied. The main difference is in the weak columella plications, particularly the nearly obsolete upper one. This is such a definite shell character that I think it warrants specific separation, particularly in view of the very different location. The shoulder of the aperture is also much more expanded.

Marginella malina Hedley. (Pl. vi, fig. 36.)

Hedley 783.

Locality.—One hundred fathoms off Wollongong, specimen figured in Aust. Museum collected by C. Hedley, 3 mm. in length. We have it also from 30–35 fathoms off Crookhaven, where the specimens are slightly smaller.

This is a well-defined species, the high expanded aperture, as high as the spire, making it easily recognizable.

Marginella ovulum Sowerby. (Pl. vi, fig. 37.)

Hedley 792.

Localities.—Six to nine fathoms, Sow and Pigs Reef, Port Jackson, the specimen figured 9 mm. in length. Also 14 fathoms off Long Reef, and 30–35 fathoms off Crookhaven.

This and the following three species form a fairly well defined section of *Marginella* in which the spire is entirely submerged, and which is perhaps worthy of at least subgeneric rank. There are, however, connecting links, and I do not think this step, in the light of our present knowledge, is justified. *Ovulum* is the largest of the group, and is a well defined and constant species.

Marginella whani Pritchard and Gatliff. (Pl. vi, fig. 38.)

Hedley 800.

Localities.—Six to nine fathoms, Sow and Pigs Reef, the specimen figured 6·5 mm. in length; 30–35 fathoms off Crookhaven.

Associated with *M. ovulum*, than which it is smaller and much narrower, and with only three instead of four columella plaits.

Marginella nympha Brazier. (Pl. vi, fig. 39.)

Hedley 788.

Localities.—Alive on seaweed at Point Halliday, the specimen figured 2 mm. in length, and also on seaweed in rock pools in numerous other localities along the coast. Also under stones and in mussel beds in North Harbour, Port Jackson. It is exceedingly abundant in shell sand on most of the outer beaches.

The animal is black. This is the smallest of this group of *Marginella*, and it is readily separated by this character alone, but the dentate outer margin is another useful recognition mark.

Marginella nielseni, sp. nov. (Pl. vi, fig. 40.)

Shell small, regularly oval, glassy and colourless, animal brown yellow. Spire entirely submerged. Aperture curved, the full length of the shell, narrow, widening anteriorly. Outer margin commencing from summit of shell, expanded in a regular curve above it, thickened, with a broad external varix, inflected, the edge not denticulate. Canal moderately broad, rounded. Columella plications three, occupying less than one-fourth the length of the aperture, the lower two strong, moderately oblique, the upper minute, separate, barely visible from in front. Length, 3·2 mm.

Locality.—Twenty-five to sixty fathoms off Bateman's Bay, weedy bottom, three specimens.

The nearest ally to this seems to be *M. flindersi*, Pritchard and Gatliff, which it generally resembles in form and size, but from which it differs in having three instead of two columella plaits. I have much pleasure in naming it after Mr. T. Nielsen, of Crookhaven, who has been continually sending me mud and sand obtained while trawling on the south coast.

Marginella rotunda, sp. nov. (Pl. vi, fig. 48.)

Shell broadly oval, of moderate size, white. Spire entirely submerged. Aperture curved, of nearly uniform width, but widening slightly anteriorly, longer than the shell. Inner margin with a broad band of callus extending right to the summit. Outer lip, commencing from summit, above which it is arched, regularly rounded, with a strong external varix, the edge thickened, slightly inflected, not denticulate. Canal fairly wide, rounded. Columella plications four, occupying about one-fourth of the total length of aperture, fairly strong, moderately oblique, the upper smaller and separate. Length, 4·4 mm.

Locality.—Thirty to thirty-five fathoms off Crookhaven.

This is a well-marked species, generally resembling *M. ovulum*, but less than half the size, broader, and with quite a different contour.

Marginella angasi Crosse. (Pl. vi, fig. 41.)

Hedley 775.

Localities.—Alive on seaweed in rock pools, North Harbour, the specimen figured 1·7 mm. in length, also under rocks, in kelp roots and in mussel beds from the same locality. This species is also very common in shell sand on the outer beaches right along the coast.

When taken alive, the animal is bright red, making it a very conspicuous little shell. With the next three species, and possibly *subbulbosa*, it constitutes still another group of *Marginella* which later may be raised to generic or sub-generic rank. These are all small species and characterized by multi-plicate columellae, the number of plications being in the neighbourhood of 6 or 7. *Angasi* seems a typical shallow-water form, and I have never seen it in dredgings from deeper water.

Marginella angasi Crosse, var. *melania*, var. nov. (Pl. vi, fig. 42.)

Locality.—Alive under rocks, North Harbour, Port Jackson, the specimen figured 1·7 mm. in length.

The animal of this variety is quite black instead of the bright red of typical *angasi.* Comparison of the shells shows no appreciable difference, the shoulder of the aperture is a little higher, but no more than can be allowed by individual variation. Only two specimens were found, and a much longer series is needed, also a study of the animals themselves, to decide finally if more than one species is indicated. It seems better, however, to put this colour variation on record with a varietal name for future reference.

Marginella amphora, sp. nov. (Pl. vi, fig. 43.)

Shell small, subtriangular, white. Spire of two or three whorls, practically involute, but just visible from in front. Body whorl inflated, with prominent shoulder, tapering anteriorly. Aperture moderately wide, widening slightly anteriorly, the outer margin joining the body whorl at the suture, and rising in an even curve well above the top of the shell, slightly flattened medially, external varix very slight, the edge greatly thickened, very slightly inflected, not denticulate. Canal wide and rounded. Columella multi-plicate, eight plications in all, occupying the greater length of the aperture, the lower pair oblique, the others becoming more transverse, the upper four small separate and transverse. Length, 2·8 mm.

Locality.—Eight to ten fathoms off Point Halliday (type). I have also seen it on the outer beaches near Sydney, and it is probably not uncommon associated with *M. angasi.*

This is another of what might be termed the *angasi* group of *Marginella*, characterized by the multi-plicate columella. It differs from *angasi* by being larger, with a different contour, and by the prolongation of the aperture above the spire. From *multidentata* May, it chiefly differs by the broad nearly truncate top of the body whorl, which in the former is greatly restricted.

Marginella multidentata May. (Pl. vi, fig. 44.)

May 680.

Locality.—In going through the Roy Bell Collection a specimen was picked out from 60 fathoms off Twofold Bay, which agrees very well with this species, the length of the specimen 3 mm. This is a new record for New South Wales. The narrow top of the body whorl and more complete involution of the spire separate it from *M. amphora* previously described.

Marginella subauriculata May. (Pl. vi, fig. 45.)

May 690.

Locality.—Shell sand, Port Stephens, several specimens, the one figured 1·3 mm. in length.

This is the smallest of our *Marginella* species, and can be readily picked out by its exceedingly broad form. It agrees very well with May's figure and description, with which it has been identified, but it is noted that *subauriculata* is described as from 40 fathoms, while this is evidently a shallow water form. This is a new record for New South Wales.

Marginella carinata Smith. (Pl. vi, fig. 46.)

Hedley 777.

Locality.—The figure is taken from a specimen in the Australian Museum, 5 mm. long, labelled as presented by Prof. W. A. Haswell, from 800 fathoms 35 miles east of Sydney. It was collected during the excursion of the "Woy Woy" in 1906, conducted by Professor Haswell.

The original *carinata* was described by Smith from material of the "Challenger" Expedition from 400 fathoms, off Sydney, the station about which there has been much controversy. Smith mentions it as having three columella plications, while the specimen here figured has definitely four. Otherwise they agree well enough.

UNFIGURED SPECIES.

Marginella agapeta Watson.

Hedley 774.

This species was described by Watson as from 35 fathoms, east of Port Jackson, hard ground, Lat. S. 33° 51′ 15″, Long. E. 151° 22′ 15″. It has not since been found in New South Wales, but May recorded it from Tasmania, and includes a figure in his check list. May's figure, however, does not conform with the original, the only point of resemblance being the three columella plaits. The Tasmanian species is evidently something different and requires re-identification or a new name. If *agapeta* really occurs in New South Wales it is surprising that it has not come to light on one of the official dredging expeditions or in material brought up by the trawlers. According to the description it should be a conspicuous shell, something like *subbulbosa*, but about twice the size and with only three columella plaits. Pending confirmation by fresh material, it must be considered as a doubtful member of the N.S.W. fauna.

Marginella brazieri Smith.

Hedley 776.

This species was procured by the "Challenger" Expedition, as from 410 fathoms, off Sydney. This is the station, about the location of which there has been much controversy, and most of the material so labelled still awaits confirmation from local waters.

Hedley included *brazieri* in the list of mollusca from 80 fathoms off Narrabeen, procured by the "Miner" (1906), but later (*Proc. Linn. Soc. N.S.W.*, 1914, XXXIX, Pl. 4, p. 725) corrected this listing, making his specimen the type of *Marginella malina* Hedley, pointing out that *brazieri* is a larger shell with more exsert spire and lives in deeper water. There are four specimens in the Australian Museum collection identified by Hedley as *Marginella brazieri* Smith, from 250 and 300 fathoms, 23–27½ miles E. of Sydney, and these appear to be the specimens from which he made his comparison between that species and *malina*. They certainly more closely resemble Smith's figure and description than any other known *Marginella* from New South Wales.

Marginella multiplicata Tate and May.

Hedley 785.

This was admitted to the New South Wales list, from one immature specimen identified by Hedley from the "Thetis" collections. The species was taken in 63–75 fathoms off Port Kembla, N.S.W. (St. 49).

Marginella pumilio Tate and May.

Hedley 786.

This was also recorded by Hedley from "Thetis" material, but only one specimen was obtained from the same station as *multiplicata*. *Pumilio* is a minute species, and further material of it, and *multiplicata*, would help considerably in substantiating their inclusion in the New South Wales list.

EXPLANATION OF PLATES.

Plate v.

Fig. 1. *Marginella turbinata* Sowerby.
Fig. 2. „ *turbinata* Sowerby var. *pusilla* Laseron.
Fig. 3. „ *olivella* Reeve.
Fig. 4. „ *infelix* Jousseaume.
Fig. 5. „ *inconspicua* Sowerby.
Fig. 6. „ *schoutanica* May.
Fig. 7. „ *punicea* Laseron.
Fig. 8. „ *pipire* Laseron.
Fig. 9. „ *strangei* Angas.
Fig. 10. „ *frequens* Laseron.
Fig. 11. „ *binivitta* Laseron.
Fig. 12. „ *victoriae* Gatliff and Gabriel.
Fig. 13. „ *sinuata* Laseron.
Fig. 14. „ *subbulbosa* Tate.
Fig. 15. „ *sinapi* Laseron.
Fig. 16. „ *translucida* Sowerby.
Fig. 17. „ *humerica* Laseron.
Fig. 18. „ *freycineti* May.
Fig. 19. „ *freycineti* May var.
Fig. 20. „ *cratericula* Tate and May.
Fig. 21. „ *stilla* Hedley.
Fig. 22. „ *quinqueplicata* Laseron.
Fig. 23. „ *mustellina* Angas.
Fig. 24. „ *haswelli* Laseron.

Plate vi.

Fig. 25. *Marginella muscaria* Lamarck.
Fig. 26. „ *tasmanica* Ten.-Woods.
Fig. 27. „ *kemblensis* Hedley.
Fig. 28. „ *mayii* Tate.
Fig. 29. „ *gabrieli* May.
Fig. 30. „ *maugeana* Hedley.
Fig. 31. „ *cuneata* Laseron.
Fig. 32. „ *geminata* Hedley.
Fig. 33. „ *ochracea* Angas.
Fig. 34. „ *ochracea* Angas var. *crescere* Laseron.
Fig. 35. „ *laeviplicata* Laseron.
Fig. 36. „ *malina* Hedley.
Fig. 37. „ *ovulum* Sowerby.
Fig. 38. „ *whani* Pritchard and Gatliff.
Fig. 39. „ *nympha* Brazier.
Fig. 40. „ *nielseni* Laseron.
Fig. 41. „ *angasi* Crosse.
Fig. 42. „ *angasi* Crosse var. *melania* Laseron.
Fig. 43. „ *amphora* Laseron.
Fig. 44. „ *multidentata* May.
Fig. 45. „ *subauriculata* May.
Fig. 46. „ *carinata* Smith.
Fig. 47. „ *johnstoni* Petterd.
Fig. 48. „ *rotunda* Laseron.

Unfigured: *M. agapeta* Watson; *M. brazieri* Smith; *M. multiplicata* Tate and May; *M. pumilio* Tate and May.

AUSTRALIAN CERAMBYCIDAE. VIII.

Notes on a Collection from the Western Australian Museum, with Descriptions of New Species.

By KEITH C. MCKEOWN, F.R.Z.S.

(Figures 1–11.)

Our knowledge of the Cerambycid fauna of Western Australia is almost entirely limited to the original descriptions of species named by workers in the group. Information regarding the geographical distribution of the species occurring in the west is very scanty. The study of the Cerambycidae from this State is, therefore, of intense interest, both by reason of the unique forms occurring in this area and the distribution of species more fully known from the eastern States.

Owing to the kindness and co-operation of Mr. L. Glauert, F.R.Z.S., Director of the Western Australian Museum, I have been enabled to examine a large collection of hitherto unworked Cerambycidae from that institution. The results of this study are embodied in the present paper. I have also included descriptions of several new Western Australian species from the collection of the Australian Museum, Sydney. A list of previously described species, together with the localities from which they were taken, has been included, in view of the importance of this information in widening our knowledge of their distribution.

From the material examined, some areas in the west are of great zoological interest. That Salmon Gums is one of these is indicated by the number of species collected there, many of them insects of diverse habitat, or closely allied species of one genus, i.e., *Elaptus*. I am indebted to Dr. J. Gentilli, Research Officer, Council for Scientific and Industrial Research, University of Western Australia, for the accompanying details concerning the climate of the Salmon Gums district, which throws considerable light on the apparently involved concentration of the species in that area.

"A Climatic Analysis of Salmon Gums, Western Australia.

"The district lies half-way between the almost arid region around Norseman, and the relatively wet coastal Esperance region. The rainfall averages 1317 points a year, thus distributed:

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	108	61	120	86	129	142	143	155	89	118	100	66
with a standard deviation of points,	156	79	82	74	72	88	53	95	44	87	79	93
i.e., per cent. of the average.	144	129	68	86	56	62	37	61	50	74	79	141
At Grass Patch the average is	71	55	114	97	170	151	151	160	115	132	97	74
with a standard deviation of points,	109	95	100	89	112	85	74	87	55	101	91	74
or per cent. of the average.	154	174	87	92	65	56	49	54	48	77	94	100

"When one considers the short distance between the two localities, the difference in the yearly total (1317 as against 1387) may be significant; but the most important fact is that the rainfall decreases sharply north of Salmon Gums and increases sharply south of Grass Patch.

"The great variability of the rainfall is shown by the standard deviations given above, especially in their percentage form; it is, however, true that winter rains are essentially reliable in July, and almost reliable in August and September. The rainfall varies between limits which are as follows:

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	
Highest	585	242	312	314	269	415	243	408	156	330	250	298	
Lowest	0	0	2	7	12	50	29	24	10	17	0	5	at Salmon Gums
Highest	598	469	361	325	426	338	332	393	230	397	347	276	and
Lowest	0	0	0	0	16	21	18	45	14	17	0	0	at Grass Patch.

"The Grass Patch figures are more reliable and significant because the records extend over 31 years, as compared with 16 years for the Salmon Gums records. The highest and lowest figures given above refer to single months, and it seldom happens that two or three very rainy months occur in the same year. In an exceptionally dry year the total rainfall may be near 6 inches, and it may be more than 18 inches in an exceptionally wet year. This means that plants and animals may have to tide over a desert climate for a period of 14 or 16 months or may enjoy an almost wet climate for a few months.

"The number of wet days per year is relatively high, between 60 and 90, which gives an average low fall per wet day less than 20 points. This fact favours evaporation of rainwater and usually hampers the soaking of the ground; it leads to salt accumulation and formation of solonized soils, with columnar clay in the subsoil, and nodules of carbonate of lime. This in turn leads to mallee carriage in many trees.

"The climate may be classified as semi-arid, half-way between the arid found north of Norseman, and the sub-humid found near Esperance. The typical dry summer of the mediterranean climate is not always present at Salmon Gums and Grass Patch, although it always occurs at Esperance. It may be said that Salmon Gums and Grass Patch have a uniform rain climate, with rainfall deficient in almost every month; this climate allows grass growth, which the summer-dry climates further west do not.

"There is little difference in the results of climatic analysis whether Köppen's or Thornthwaite's systems be applied.

"According to Köppen's formulae, the cool-summer climate begins just south of Grass Patch, and the whole area is—on the average—cool, the warm climates beginning near Kalgoorlie; according to Thornthwaite's formulae, there are no cool climates in this region, which is entirely warm."

I am indebted to Mr. L. Glauert for making this interesting collection available to me for study; to Dr. J. Gentilli for the climatic details of the Salmon Gums district, given above, and to Miss N. B. Adams, of the Australian Museum, for the very fine and detailed figures which add greatly to the value of this paper.

CERAMBYCIDAE.

PRIONINAE.

Brephylidia jejuna Pasc.--Mossman.

Cnemoplites sp.—Salmon Gums (42–890).

There is only one specimen of this interesting insect in the collection. It appears inadvisable to describe it in the absence of further material. It closely resembles *C. howei* Thoms. from Lord Howe Island. It will probably prove to be new.

Elaptus (*Myiocydus*) *brevicornis* Pasc.—Salmon Gums, Mt. Johnson.

Elaptus (*Myiocydus*) sp.—Salmon Gums (41–440).

Differs from the preceding species by the more rounded anterior angles of the prothorax. More material is necessary before its status as a species can be determined.

Elaptus (*Myiocydus*) sp.—Salmon Gums (43–52).

A larger and more coarsely punctate insect than the preceding, with the prothorax evenly rounded laterally and almost completely nitid and impunctate. It is too damaged for determination, but may be the female of the last-mentioned insect.

CERAMBYCINAE.

Xystrocera virescens Newm.—Rottnest Island.
Pachydissus sericus Newm.—Yanrey Station, Dedari, and Mt. Egerton.
Pachydissus boops Blkb.—Geraldton.
Phacodes modestus Blkb.—Mt. Wynne.

Phacodes singularis, sp. nov.

(Fig. 1.)

Robust, black; elytra with six irregular cream spots.

Head medium; eyes small, finely granulate; frons and face densely clothed with erect hairs. Antennae slender, short, scarcely reaching beyond insertion of hind femora; scape broad, curved, subnitid, coarsely punctate; joints 3–4 equal, swollen at apex, 5–6 subequal, longer than 4, slightly thickened at apex, 7–11 simple, progressively shorter, 1–4 with scattered setae, 1–5 bearing stout erect apical setae. *Prothorax* rounded, dorsally depressed, shagreened, with three small nitid tubercles and two punctate, subnitid tubercles on disc; clothed with dense erect yellowish hair. *Scutellum* triangular, margined with buff pile. *Elytra* broader than prothorax at widest, dorsally depressed, parallel-sided to within three-fourths, then contracting roundly to apex; apices rounded, divergent; disc of elytra feebly tuberculate on dark areas, punctate on pale, clothed with sparse erect hairs. Pale markings are (1) an irregular blotch at one-fourth not reaching suture, contracting sharply at lateral declivity and then broadening to form a narrow stripe along lateral margin from shoulder to a little beyond one-half, (2) an irregular lunulate blotch at about three-fourths reaching lateral margin but not suture, and (3) an oblique semi-hyaline area over elytral apices, reaching lunulate blotch, extending from suture to lateral margin. *Legs* black, slender, femora moderately expanded, tarsi long, narrow. *Under surface* black, subnitid; abdominal segments sparsely, posterior closely and finely punctate; clothed with erect stramineous hairs, densest on prosternum. Long. 13 mm.; lat. 4 mm.

Narrogin.

Holotype (unique) in Western Australian Museum (37–4588). Unlike any member of the genus known to me. Very distinctive in the pale elytral blotches.

Oebarina ceresioides Pasc.—Rottnest Island.

Phoracantha punctata Don.—Geraldton, Wadgingarra, Mt. Egerton, Katanning, Laurier, Darlington, Rottnest Island.

A widely distributed species, usually named as *P. quinaria* Newm. in collections.

Phoracantha semipunctata Fabr.—Salmon Gums and Gnowangerup.

Phoracantha recurva Newm.—Forrest River district, Mt. Johnson, Rottnest Island.

The specimen from Forrest River district (1915–784) has the prothorax, legs and antennae light reddish in colour. It may not be fully mature, but is similar to material received from Papua.

Phoracantha tricuspis Newm.—Rottnest Island.
Tryphocaria hamata Newm.—Harvey.
Tryphocaria princeps Blkb.—Dingup, and W. Midland.

Tryphocaria northamensis, sp. nov.

(Fig. 2.)

♂. Robust, elongate-oblong; ground colour of elytra orange-brown; head, prothorax and elytral markings black; underside dark castaneous; legs dark castaneous, tarsi paler.

Head rugose, sulcate. Antennae reaching to apex of elytra, joints 3–6 weakly bispinose at apex, spines of almost equal length, 7–10 apices only slightly produced exteriorly, joints 3–5 equal, 6–10 each successively shorter than preceding, 11 longer than 10. *Prothorax* transverse, 11 × 6 mm. with strong lateral spines, extremely rugose with a nitid median tubercle, depressed and finely punctate in centre, situated near base.

83088

Scutellum triangular, black, nitid. *Elytra* 22 × 10 mm., laterally rather strongly marginate, apices obliquely subtruncate, bispinose, external spine longer and stouter, disc coarsely and cellulose-punctate, the punctures large and deep, becoming shallow and obscure over apical half, especially on black marking, two raised costae on each elytron, neither quite reaching apex, that furthest from suture most strongly defined. Elytral markings may be divided into (1) a broad basal black fascia broadest at suture, extending from lateral margin, along which it continues narrowly, as along suture, (2) a preapical patch not reaching lateral margin, but reaching and including apical spine, (3) antemedian narrow N- or H-shaped marking with anterior and posterior dark areas. Over the two elytra the dark area formed is somewhat shield-shaped. *Under surface* dark castaneous, subnitid; prosternum and abdominal segments lightly punctate, clothed with a short, sparse stramineous pile.

Long. 28 mm.; lat. 10 mm.

Northam.

Holotype (unique) in Australian Museum, Sydney. (K67659.)

This, one of the smaller species of the genus, appears to come nearest *T. princeps* Blkb. (from the description and H. J. Carter's notes) with the following differences: (1) apical spines of antennal joints inconspicuous. Blackburn states that those of *princeps* are "much stronger than those of *P. hamata* and *odewhani*", (2) "on the elytra, none of the fasciae quite reach the elytral margins and only the basal one touches the suture in *princeps*", (3) that there are five nitid tubercles on the prothorax of that species.

Epithora undulata Hope—Wurarga, and Rottnest Island.

Coleocoptus senio Newm.—W. Midland.

Coptocercus sannio, sp. nov.

(Fig. 3.)

Slender, reddish-black, elytra with three irregular black fasciae.

Head small, clothed with grey pile, punctures small and dispersed. Antennae slightly exceeding length of body; apices of joints 3–6 unispinose. Joint 1 regularly and somewhat coarsely punctate, 3 longer than 1, 4–6 subequal shorter than 3, 4 longer than 7, 8–11 subequal shorter than 7; 1–7 clothed with long recumbent pile and stiff erect hairs, 8–11 pruinose; terminal joint obliquely acute at apex. *Prothorax* very slightly longer than broad, constricted anteriorly and to a less degree posteriorly; a small lateral tubercle behind anterior margin and a strong lateral tubercle at half-way; disc with a raised median line, a prominent black nitid median tubercle and four smaller ones equidistant from it, each pair connected by a raised curved line forming a C-shaped mark (reversed on right) on each side of prothorax; whole of prothorax covered with dense greyish pile. *Scutellum* small, rounded posteriorly, clothed with dense grey pile. *Elytra* narrow, parallel, wider than prothorax at base, converging roundly to apex, apices somewhat divergent from about two-thirds, truncate, external angle forming a blunt tooth; disc coarsely punctate basally, punctures becoming finer to about two-thirds; from upper edge of apical dark fascia almost obsolete. Dark markings are (1) an apical fascia extending from lateral margin to suture, broadest at its extremities, (2) ψ-shaped median fascia connecting narrowly at suture with those before and behind, and (3) an irregular fascia covering apices and completely enclosing an elongate-oval pale macula. *Legs* reddish-fuscous, slender, femora narrowly clavate, peduncles narrow, sparsely clothed with fine grey recumbent pile. *Under surface* blackish-brown, sub-nitid, finely punctate, clothed with sparse grey hairs.

Long. 18 mm.; lat. 4 mm.

Hopetown (38–2326) and Rottnest Island (31–1966).

Holotype (Hopetown) in Western Australian Museum; paratype in Australian Museum, Sydney. (K67660.)

This very distinctive and decorative species comes closest to *C. rubripes* Boisd., but differs in its more robust form, truncate instead of bispinous elytral apices, more slender femora, broader prothorax, and difference in sculpture of prothorax, elytral pattern, darker legs, etc. In abraded specimens the antennae and prothorax are almost naked, and the tubercles of the prothorax show in entirety instead, with the exception of the central boss, of beneath the clothing; the medial tubercle appears more oval in outline.

Atesta tatei Blkb.—Salmon Gums.

Didymocantha novica Blkb.—Salmon Gums.

Didymocantha picta, sp. nov.

(Fig. 4.)

Robust, black, elytra yellow and black.

♀. *Head* black, subnitid, finely and closely punctate, clypeus clothed with erect hair, a small erect tuft behind eye. *Antennae* shorter than body, with sparse erect hairs; joint 1 nitid, coarsely punctate, 3–4 subcylindrical, 5–10 flattened, 1, 3, 5–8 subequal, 4, 8 and 10 equal, shorter than preceding group, 9 shorter; 1–2 black, 3–5 yellow tipped with black at apex, 6 half black, remainder sooty. *Prothorax* slightly broader than long, black, coarsely and evenly punctate, three small lateral tubercles—rear one largest, nitid; disc with five small nitid tubercles. *Scutellum* triangular, black. *Elytra* subnitid, with sparse erect hairs, punctures medium, two ill-defined raised costae on disc, that nearest suture reaching apex, a strong linear depression extending from opposite external thoracic angle to inner costa at about one-eighth; apices rounded. Dark elytral marking consists of an irregular fascia in line with the posterior coxae narrowing to suture and again expanding over elytral apices; lateral margin narrowly black. *Legs* black, femora obscurely punctate, all tibiae ringed with yellow towards apex. *Under surface* black, nitid, finely punctate; abdomen passing elytral apices.

Long. 19 mm.; lat. 5 mm.

Edjudina.

Holotype (unique) in Western Australian Museum.

This very distinctive species comes nearest to *D. brevicollis* Pasc., but is readily distinguished by the very much shorter antennae in the female, absence of basal dark fascia, etc.

Bethelium inconspicuum, sp. nov.

Medium, brown, each elytron with two cream spots.

Head small, reddish, very densely and coarsely rugose-punctate, with erect hairs. Antennae stout, longer than body, basal joint closely punctate; joints 3 and 5–8 equal, as long as 1, remainder decreasing progressively; densely clothed with long white hairs. *Prothorax* reddish, rounded, constricted basally, very coarsely rugose-punctate. *Scutellum* large, triangular. *Elytra* subnitid, coarsely punctate, punctures frequently coalescing, becoming less defined towards apex but clearly defined over pale markings; a relatively paler area about middle; cream markings consist of (1) a narrow oblique stripe extending from lateral margin about basal third, not reaching suture, (2) a large, somewhat oblique oval spot touching neither lateral margin nor suture, situated at about apical third; apices narrowly rounded. *Legs* dark brown, femora strongly clavate, subnitid, finely and sparsely punctate, tibiae finely and closely punctate; clothed with suberect hairs. *Under surface* dark brown, prosternum paler.

Long. 8 mm.; lat. 2 mm.

Salmon Gums.

Holotype (unique) in Western Australian Museum (33-2392).

A very distinctive little species; comes nearest to *B. spinicorne* Blkb., but lacks the antennal spines characteristic of that species, and is more robust. It differs also in the form and distribution of the pale areas on the elytra.

Neostenus morio Pasc.—Geraldton, Mt. Jackson, Rottnest Island.
Neostenus saundersi Pasc.—Muccan, Salmon Gums, and Geraldton.
Maltheba flexilis Pasc.—Witchcliffe and Darlington.
Aposites gracilis Blkb.—Midland.
Aphanasium australe Bois.—Margaret R., Cottesloe, Darlington.
Opsidota albipilosa Pasc.—Negumber, Mullewa and Yalbalgo.
Opsidota infecta Pasc.—Salmon Gums, Laverton, Norseman and Yalbalgo.
Scolecobrotus bimaculatus Lea—Lake Violet.
Uracanthus gigas Lea—Wadingarra.

A smaller specimen than indicated by the type measurements.

Uracanthus pertenuis Lea—Milly Milly.
Uracanthus discicollis Lea—Salmon Gums and Perth.
Uracanthus simulans Pasc.—Mullewa and Laverton.
Uracanthus bivittatus Newm.—Wembley.
Uracanthus triangularis Hope—Rottnest Island.

Uracanthus regalis, sp. nov.

(Fig. 5.)

Robust, clothed with buff and grey pile; each elytron with a conspicuous subtriangular glabrous lateral area at about one-fourth elytral length margined with denser clothing.

♀. *Head.* Muzzle almost as broad as long; clypeus with scattered punctures, rounded posteriorly; suture deep and broadest posteriorly. Antennae slender, not passing third abdominal segment; 5th to 10th joints rather feebly produced to one side at apex, 10th about two-thirds length of 11th, 11 rather strongly curved. *Prothorax* at base slightly narrower than long, tapering strongly to apex; densely clothed with long recumbent buff pile with a sublateral stripe, broadest apically, of paler grey pile. *Elytra* relatively broad, tapering very slightly to apex, somewhat divergent at apices; apices laterally broadly rounded with a small notch at extreme termination with an acute inner tooth; three feebly elevated longitudinal costae reaching almost to apex; densely clothed with recumbent mixed buff and grey pile tending to be concentrated in regular longitudinal lines; derm of subtriangular glabrous areas much darker than that of underlying pilose area, pile somewhat concentrated along margins; glabrous area rather rounded anteriorly and extending towards shoulder only at extreme margin. *Legs* slender and of medium length, clothed with close buff pile, densest on tibia; tarsi fringed with golden hairs. *Under surface* densely clothed with recumbent fleecy grey pile. Long. 37 mm.; lat. 8 mm. A second specimen in Mr. W. du Boulay's collection measures 34 x 7 mm.

Denmark.

Holotype in Australian Museum, Sydney (K67661).

This magnificent species has a strong superficial resemblance to *U. triangularis* Hope on account of the subtriangular glabrous elytral areas. It is larger, and its robust form more like that of *U. cryptophagus* Olliff. The notched elytral apices serve readily to distinguish it from *U. triangularis*, which has the apices squarely truncate and bispinose.

Uracanthus multilineatus, sp. nov.

(Fig. 6.)

Slender, brown, each elytron with five (including sutural) grey pilose, parallel longitudinal lines.

Head broader than prothorax at anterior margin; muzzle short, broad. Antennae reddish-brown, longer than body, slender, joints 3–10 obliquely produced to one side at apex, 11 simple, 4–10 compressed; joint 1 small, 4–8 subequal, longer than 3, 9–10 subequal shorter than 4, 11 almost as long as 9–10 combined, curved. *Prothorax* longer than wide, contracted apically, basal half almost parallel-sided, tuberculate about half-way, densely and uniformly clothed with long woolly pile; where exposed by abrasion, disc finely ridged transversely. *Scutellum* very small, clothed with fine grey pubescence. *Elytra* narrow, parallel-sided, apices truncate with a small acute spine on sutural angle, exterior angle rounded; four narrow parallel almost equidistant longitudinal lines of close grey pile on each elytron, none of which reaches apex, 1st and 2nd lines converging and intersecting apically; suture is also narrowly margined with grey; interspaces clothed with sparse recumbent grey pile, darker than lines, except that between costae 3–4 where it is buff. Exposed derm of interspaces brown, coarsely and closely punctate basally, punctures becoming progressively smaller and obsolete to apex. *Legs* reddish-brown, long and slender, with sparse whitish pile. *Under surface*: prosternum with dense grey pile; abdominal segments pubescent, 3 basal segments with a densely pilose medio-apical spot.

Long. 19 mm.; lat. 3 mm.

Lake Violet.

Holotype (unique) in Western Australian Museum (27–1497).

A very distinctive species unlikely to be confused with any other; comes closest to *U. strigosus* Pasc., but differs in the elytral lines, non-vittate prothorax, and in the elytral apices, which in *strigosus* are strongly emarginate and acutely bispinose.

Uracanthus fuscostriatus, sp. nov.

Medium, black, densely and evenly clothed with ash-grey pile, a dark-brown pre-lateral and a white lateral stripe.

♂. *Head* large, muzzle short, as broad as long, clypeus triangular, finely punctate; median sulcus deep and well defined; eyes large, coarsely granulate; frons and face clothed with coarse ashy to pale buff pile. Antennae not as long as body, reaching beyond apices of hind femora, brown, pubescent; joints 4–8 feebly produced to one side apically; joint 1 black, nitid, glabrous, finely punctate, with sparse pile, joints 3, 5–10 equal, 4 shorter, 11 longer. *Prothorax* one-fourth longer than wide, contracting apically and parallel-sided basally from half-way, where there is a strong lateral tubercle; disc with indications of three small tubercles in line with lateral one, but concealed by pile; coarsely punctate; transversely ridged; clothed densely but irregularly with long ash-grey pile. *Scutellum* very small, posteriorly rounded, pilose. *Elytra* contracting slightly to two-thirds, then expanding somewhat before rounding to apex; apices rounded, slightly and obscurely notched, with a minute tooth on sutural angle; densely and uniformly clothed with short ash-grey pile merging gradually into a broad longitudinal brown stripe, followed on the lateral margin by a similar stripe of ashy-white; a narrow tapering nitid glabrous area on edge of lateral declivity extending from shoulder to one-third. *Legs* stout, clothed with short ashy pile, densest on lower edge of femora. *Under surface* uniformly clothed with short ashy pile with the exception of a rounded, nitid glabrous medio-apical spot on the four basal abdominal segments; derm finely and closely punctate; extremity of abdomen projecting slightly beyond apices of elytra.

Long. 30 mm.; lat. 5 mm.

Maylands.

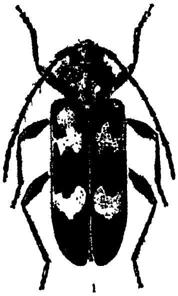
Holotype (unique) in Western Australian Museum (32–242).

A fine species, structurally close to *U. ater* Lea, but readily distinguished by the brown pre-lateral and white lateral stripes.

Uracanthus dentiapicalis, sp. nov.

(Fig. 7.)

Slender, piceo-castaneous, rather densely clothed with ashy pubescence, longest basally, dense and pilose laterally. Apices obliquely truncate, angles toothed; elytra with a strong convex ridge extending from shoulder to external apical angle.



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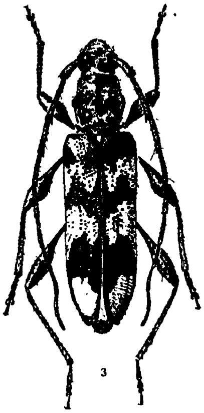

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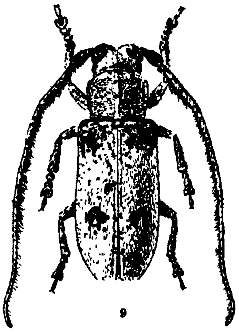

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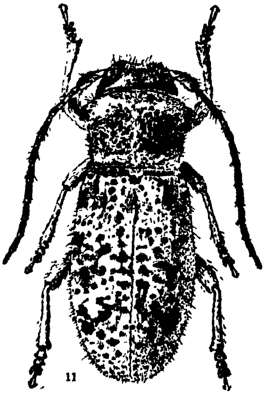

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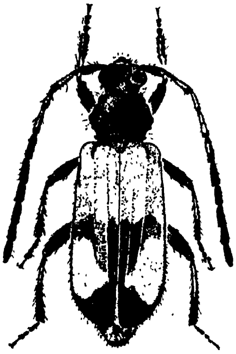

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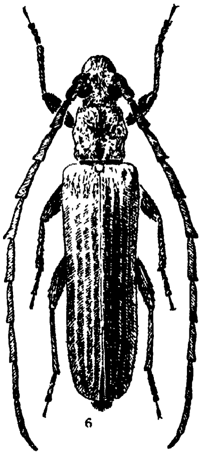

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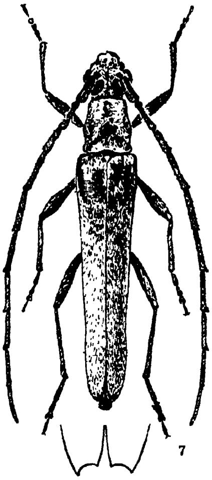

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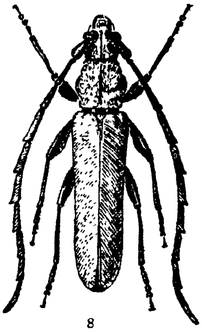

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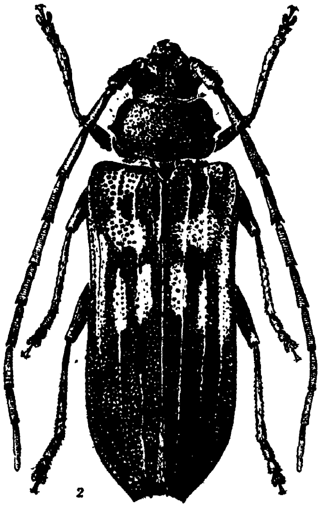

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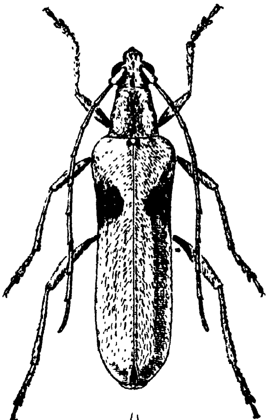

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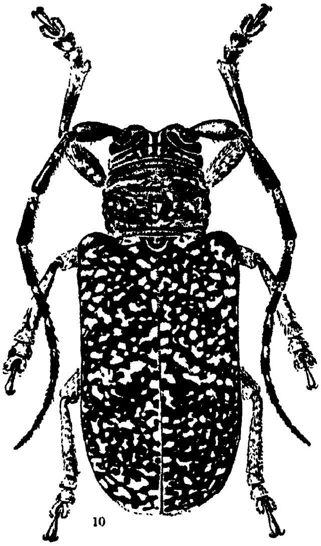

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Head small, muzzle short, broader than long, median line very deep and broad between antennal bases, narrow but sharply defined to base; densely clothed with long recumbent ashy pile; eyes large, coarsely granulate, emargination filled with dense grey pile; antennal bases prominent. Antennae slender, slightly longer than body—half apical joint passing elytral bases—clothed with ashy pubescence; joints 4–10 feebly produced on one side at apex, 4–7 strongest; 1, 3–4 equal, 5–9 and 11 equal, longer than 4, 10 shorter than 5. *Prothorax* longer than broad (at base), narrowest at apex, increasing regularly to about basal third where it is laterally obscurely tuberculate, strongly ridged transversely on median line, on basal half corrugations not extending to sides; evenly and densely clothed with woolly grey pile. *Scutellum* bluntly triangular, clothed with grey pile. *Elytra* narrow, very slightly wider than prothorax at base, almost parallel-sided, slightly constricted about half elytral length and tapering shortly before apex; apices obliquely truncate, angles toothed; disc obscurely shagreened; a broad convex ridge runs down the centre of each elytron from about shoulder to external apical tooth, leaving elytra somewhat marginate laterally and suturally; clothed with ashy pubescence, densest basally and laterally. *Legs* slender, dark piceo-castaneous, sparsely pilose, that on lower surface of fore and middle femora densest. *Under surface* pitchy, sterna with dense ashy pile; abdominal segments sparsely pubescent.

Long. 20 mm.; lat. 3 mm.

Wandadgee Station.

Holotype (unique) in Western Australian Museum (41–740).

A slender species coming near *U. tropicus* Lea, but obliquely truncate and not deeply emarginate on the elytral apices, and the angles toothed rather than spinose, that on the external angle being strongest. The strong convex ridge on the elytron is a very distinctive feature. There is an almost glabrous area near the base of each elytron, but this is almost certainly due to abrasion, since the clothing upon the right elytron is much more continuous than on the left, and the area of exposed derm more irregular.

Emenica fulva, sp. nov.

(Fig. 8.)

Slender, subcylindrical, black, densely clothed with rich fulvous pile, legs and antennae black.

♀. *Head* bright fulvous, nitid, antennal tubercles, mandibles and eyes black, median sulcus deep, clearly defined, muzzle almost as long as head, clypeus oval. Antennae slightly longer than body, joints 4–10 somewhat flattened, slightly expanded externally at apex, 11 slender; joint 3 as long as 1, 4 shorter than 3, 5–6 equal, longer than 4, remainder decreasing progressively with the exception of 11 which is as long as 5; 1–3 nitid, 1 densely and closely punctate, 3 with strong transverse ridges, 3–11 clothed with sparse glistening golden pile. *Prothorax* longer than wide, slightly narrower than elytra at base, strongly constricted anteriorly, swelling regularly laterally to centre, then again constricted to base, hind border marginate. *Scutellum* scutiform, densely pilose. *Elytra* narrow, parallel, with indications of two obscure longitudinal costae; apices rounded; densely clothed with bright fulvous pile, long and adpressed. *Legs* slender, with indications of sparse golden pile similar to antennal clothing. *Under surface* black, prosternum finely punctate, with sparse fulvous pile; abdomen scarcely longer than elytra.

Long. 14 mm.; lat. 3 mm.

♂. Similar to female but smaller; prothorax swelling regularly from base to apex; antennae more pilose and legs redder.

Figures 1-11.

1. *Phacodes singularis.* 2. *Tryphocaria northamensis.* 3. *Coptocercus sannio.* 4. *Didymocantha picta.* 5. *Uracanthus regalis.* 6. *Uracanthus multilineatus.* 7. *Uracanthus dentiapicalis.* 8. *Emenica fulva.* 9. *Platyomopsis delicatula.* 10. *Rhytiphora cruoensis.* 11. *Corrhenes glauerti.*

N. B. Adams, del.

Long. 12 mm.; lat. 2 mm.

Kukerin and Lake Wingham.

Holotype ♀ and allotype ♂ in Western Australian Museum (36–4828, 33–63).

This small but striking species is, from Pascoe's description, very distinct from *E. nigripennis*, which is unknown to me, both in the colour of the clothing of the elytra, and that the end of the abdomen scarcely protrudes beyond the apex of the elytra.

Piesarthrius gearyi McK.—Mt. Wynne.

It is extremely interesting to find this fine species occurring in Western Australia. It was originally described by me from a unique example from Cunnamulla, south Queensland. I have seen only one other specimen, taken at Rockhampton, Queensland, in Mr. W. du Boulay's collection.

Pseudocephalus mirus Pasc.—Scarboro'.

Rhinophthalmus nasutus Shuck.—Cottesloe.

Bimia bicolor White—Jarrahdale.

Earinis purpureipes Lea—Darlington.

Hesthesis cingulata Pasc.—Hamel.

Trichomesia newmani Pasc.—Wellard and Perth.

Pytheus erosus Macl.—Perth.

Pytheus pulcherrimus Pac.—Rottnest Island.

Homaemota basalis Pasc.—Rottnest Island.

LAMIINAE.

Microtragus mormon Pasc.—Kulkerin.

Microtragus arachne Pasc.—Montebello I., and Wandadgee.

Ancita didyma Blkb.—Dedari and Pringles.

Ancita lineola Newm.—Subiaco and Donnybrook.

Ancita niphonoides Pasc.—Lake Violet.

Ancita ? fuscicornis Germ.—Jarrahdale and Harvey.

Ancita marginicollis Boisd.—Esperance.

Ancita sparsa Pasc.—West Perth.

Ancita longicornis, sp. nov.

Robust, brown, clothed with dense mixed brown and grey pile, a transverse brush of erect dark-brown hairs near elytral bases, and an oblique narrow dark-brown mark towards apex; antennae much longer than body.

♂. *Head* as wide as prothorax at base, coarsely punctate, eyes medium, coarsely granulate, irregularly clothed with coarse brown pile; greyish on cheeks where it is speckled with black. Antennae nearly two and a half times as long as body, with close adpressed pile, black on about apical fourth of each joint, remainder grey; basal joint stout, strongly dilated apically, grey pile longer than brown and concentrated in small flake-like patches, 2 beaker-shaped, tapering strongly to base, joints 3–4 equal, considerably longer than 1, 5–6 equal, shorter than 3, 7–9 progressively decreasing in length, 10–12 equal, shorter than 7; fringed beneath, joints 3–5 thickly fringed and 3–7 apically tufted. *Prothorax* strongly transverse, length about half that of breadth inclusive of spines, irregular, with a stout acute lateral tubercle at about three-quarters, basally constricted, marginate, disc with three large irregular tubercles forming a prominently elevated transverse area; a minute nitid black pustule situated on lateral tubercle; coarsely and sparsely punctate; densely clothed with recumbent mixed brown and grey pile, grey concentrated laterally and in centre of disc. *Scutellum* small, cordate with vertical median groove. *Elytra* broader than prothorax at base (of equal breadth including lateral tubercles), parallel-sided to two-thirds then rounding to apex; apices with external angle rounded, sutural bluntly angulate; suture strongly marginate over apical third; laterally marginate; disc coarsely punctate, with minute glabrous tubercles or pustules, densely clothed with mixed grey and brown pile concentrated in distinct tufts; a large elongate crest of dark brown hairs lying transversely behind scutellum, and an oblique brown line running inwards from, but not touching, lateral margin at about insertion of hind femora almost to sutural margination. *Legs* densely clothed with ash-grey pile varied with small black spots; femora strongly clavate; middle and hind tibiae with erect white hairs. *Under surface* densely clothed with buff pile varied with black spots.

Long. 15 mm.; lat. 7 mm. Antennae 37 mm.

Edjudina.

Holotype (unique) in Western Australian Museum (37–313).

A very distinct species coming closest to *A. niphonoides* Pasc. in elytral marking, but actually very distinct from it. Its exceptionally long antennae and the curious tufted elytral clothing should serve to distinguish it quite readily from all other species.

Disterna forrestensis, sp. nov.

Medium, dark castaneous, clothed with ash-grey pile; elytra with scattered glabrous spots.

Head small; eyes small, finely granulate; antennal tubercles prominent; face and cheeks with close white pubescence. Antennae slender, slightly longer than body; basal joint with sides almost parallel, finely and closely punctate, with sparse whitish pubescence; joint 3 very long and slender, remainder progressively decreasing in length; joints 4–10 basally ringed with white pubescence. *Prothorax* as long as wide at base; a short, acute lateral spine rising from a broad swelling base at about three-quarters from apex; disc with two transverse ridges, strongest at sides, depressions filled with ashy pubescence. *Scutellum* small, semicircular, pilose. *Elytra* broader than prothorax, including spines, parallel-sided to apical fourth then tapering gradually and roundly to apex; apices shallowly emarginate, angles obscurely toothed, exterior strongest; a raised longitudinal costa rising obscurely on elytral base half-way between shoulder and suture and becoming gradually more strongly defined to its termination on external apical tooth; densely pilose throughout, except for numerous small scattered glabrous spots, each with a large circular puncture at its centre; at about apical seven-eighths, an impunctate area forms a transverse fascia. *Legs* densely pubescent, a glabrous band encircling hind femora. *Under surface* densely clothed with ashy pile varied with minute glabrous spots; centre of abdominal segments nitid, glabrous, the glabrous area on each segment extending laterally in a curved line.

Long. 11 mm.; lat. 4 mm.

Forrest River district.

Holotype (unique) in Western Australian Museum (1915–369). Comes nearest to *D. pumila* Pascoe, but is more robust in form and lacks the dark basal elytral marking of that species; the clothing, too, is considerably longer and denser.

Disternopsis pentheoides Pasc.—Perth.
Platyomopsis lenta Blkb.—Landor Station.
Platyomopsis fulvescens Pasc.—Mt. Wynne.
Platyomopsis pubiventris Newm.—Salmon Gums.
Platyomopsis duboulayi Pasc.—Bickley, Hamel.
Platyomopsis pedicornis Fabr.—Koolan Is., and Tambrey Station.
Platyomopsis arctos Pasc.—Katanning, Koorda and Mt. Helena.
Platyomopsis satelles Pasc.—Tolga.
Platyomopsis cinerascens Auriv.—Wamerusking.
Platyomopsis devota Pasc.—Warrawaguine and Tambrey Station.
Platyomopsis lateralis Pasc.—Midland.
Platyomopsis fraseri Blkb.—Menzies.
Platyomopsis farinosus Pasc.—Caversham.

Platyomopsis obliqua Don.—Forrest R. dist., Lake King, Milly Soak.
Platyomopsis ferruginea Auriv.—Salmon Gums, Three Springs.
Platyomopsis modesta Blkb.—Esperance, Geraldton, Rottnest I.
Platyomopsis satelles Pasc.—Lake Violet.

Platyomopsis canus, sp. nov.

Slender, dark red-brown; head densely clothed with white pile; a silvery-white lateral elytral stripe.

♂. *Head* medium; eyes small, finely granulate; antennary tuberoles large and prominent; entirely clothed with dense, closely adpressed recumbent white pile. Antennae stout, longer than body, densely clothed throughout with white pile and profusely fringed beneath with long white hairs; basal joint stout, swollen; derm nitid, very finely punctate; joints 3–4 equal, remainder progressively decreasing in length. *Prothorax* as wide as long, sides evenly rounded, apex slightly constricted, fore margin straight, as broad as head, base strongly constricted, disc granulate-punctate, sparsely pilose, densest apically and basally. *Scutellum* small, scutate, pilose. *Elytra* wider than prothorax, parallel-sided to apical fourth, then converging roundly to apex; apices squarely truncate and fringed with hair; shallowly and somewhat coarsely punctate; base with scattered shining granules; clothed with sparse grey and buff pubescence, thickest apically and basally; a lateral stripe of dense silvery-white pile, irregularly notched along upper margin, commencing, and at its broadest, just behind shoulder and tapering gradually to apex. *Legs*: first and second femora densely clothed with snowy pile, hind buff, speckled. *Under surface* sparsely clothed with grey pile, dense on sterna. Sexual clothing on second abdominal segment buff.

Long. 14 mm.; lat. 3 mm.

♀. Similar to male, but larger; antennal joints decreasing progressively; 3rd considerably longer than 4th; sides of prothorax straighter.

Long. 16 mm.; lat. 4 mm.

Cue, Mt. Jackson, Ankertell.

Holotype ♂ (K37063) and allotype ♀ (K37063) in Australian Museum, Sydney; paratype ♀ in Western Australian Museum (39–346). An extremely distinctive little species nearest to *P. mjöbergi* Auriv. in form, but easily distinguished by the conspicuous grey pilose head and snowy fore and middle tibiae. The antennae of the female allotype are damaged, but the complete antenna would be shorter than the body.

Platyomopsis delicatula, sp. nov.

(Fig. 9.)

Comparatively slender, black, densely clothed with white pile varied with bright buff; shoulders sub-glabrous, and with a dark-brown pilose area on each elytron at about apical third.

♂. *Head* broad, concave between antennary tubercles, median line narrow but sharply defined; clothed with dense white pile. Antennae stout, considerably longer than body; joints progressively decreasing from 3 to apex, clothed with recumbent white pile and densely fringed beneath with long black hairs; basal joint with large scattered punctures. *Prothorax* much narrower than elytra at base, transverse broader than long, almost parallel-sided, slightly constricted at apical fourth; disc with large sparse punctures; median raised longitudinal line clearly defined; clothed with long recumbent white pile. *Scutellum* large, semicircular. *Elytra* subcylindrical, parallel-sided, apices truncate; densely clothed with white pile with large scattered punctures revealing the derm beneath; shoulder area with dark subglabrous derm, and numerous round, nitid tubercles projecting through light buff pile; an irregular area of dark brown and buff pile at apical third. *Legs* stout, uniformly clothed with dense white pile. *Under surface* densely pilose.

Long. 15 mm.; lat. 5 mm.

♀. Similar to male but more robust, with buff pile on head, prothorax and elytra, on the latter dispersed in small patches over almost the entire area. Antennae longer than body, but shorter than in male.

Long. 15 mm.; lat. 6 mm.

Carnarvon (H. W. Brown).

Holotype ♂ and allotype ♀ in Australian Museum, Sydney (K67662). Comes nearest to *P. humeralis* White, but differs in the almost straight sides to the prothorax, unicolorous antennae, smaller size, etc.

Rhytiphora crucensis, sp. nov.

(Fig. 10.)

Robust, black, sparsely clothed with scattered patches of dense ochreous and white pile.

♂. *Head* broad, as wide as prothorax at narrowest, coarsely and sparsely punctate, suture deep; margined laterally with white and ochre pile (broken between antennary tubercles); vertex with a transverse row of small white pilose spots; eyes black, margined with snowy-white pile; clypeal suture straight; clypeus fringed with long white and buff hairs. Antennae stout, almost reaching apices of elytra; black, fringed beneath with concolorous hairs; base of joint 3 spotted and 4–9 ringed with white. *Prothorax* transverse, broader than long, strongly corrugated transversely; wider than head in centre, but strongly constricted apically and posteriorly, with three distinct transverse bands of minute pilose white spots, corrugations filled with brown pile giving the prothorax a general brownish tint. *Elytra* parallel-sided, apically broadly rounded, shoulders prominent, pustulose, pustules (sometimes coalescing) most prominent on anterior half, posterior with a few large scattered punctures showing between pustules; sparsely clothed with small scattered compact patches of mixed ochre and white pile, which in many cases appear to occupy depressed areas between the pustules; these spots tend to be concentrated along suture and to form an obscure pattern on each elytron. *Under surface*: prosternum brown with small white spots; abdominal segments mottled ochre and white, with dense sexual clothing of buff. *Legs* stout, short, femora and tibia densely clothed with ochreous pile varied with white spots; knees black; tarsi black fringed short golden hair.

Long. 21 mm.; lat. 8 mm.

♀. Similar to male; antennae not reaching beyond two-thirds elytral length; abdominal segments mottled ochre and white.

Long. 23 mm.; lat. 8 mm.

Southern Cross (H. W. Brown), Borden.

Holotype ♂ and allotype ♀ in Australian Museum, Sydney (K67663).

Paratype ♀ in Western Australian Museum.

This short and stoutly built species may be considered to come closest to *R. saundersi* Pascoe, but since its proportions are shorter and stouter, the pilose spots much smaller and the elytra much more pustulose, it is impossible to confuse the two. A male in the Australian Museum Collection has the interspaces between the pilose spots with a dull brownish pubescence similar to that on the prothorax, but there it is denser. In the other specimens before me the derm is quite naked; it is possible that this is a freshly emerged example, and that the elytral pubescence is shed easily, and is not due to abrasion. Another male in the Western Australian Museum Collection is much smaller than the typical, measuring 16 × 5½ mm.

Rhytiphora argenteolateralis, sp. nov.

Robust, black, elytra clothed with mixed grey and buff pile tending to form small dense spots; lateral margin broadly silvery-white.

♂. *Head* large, glabrous with a few sparse punctures; face, cheeks, and an oblique stripe behind eyes buff, pilose; eyes margined with whitish pile. Antennae stout, shorter than body, reddish-brown clothed with black and irregularly spotted with dense white pile; fringed beneath with black hairs. *Prothorax* almost parallel-sided, clothed with close recumbent blackish pile varied by a narrow posterior and anterior transverse line of bright buff pile with irregular spots of the same colour over intervening area; corrugation slight, irregular. *Scutellum* semicircular, surrounded by a smooth, convex raised rim, centre depressed and filled with grey pile. *Elytra* clothed uniformly with close greyish pile and concentrated spots of grey and buff of greater length forming numerous small tufts or spots through which protrude small glossy tubercles, most numerous on basal fourth; a broad lateral silvery-white longitudinal stripe with a row of minute spots of nitid derm along upper margin; derm of elytra (exposed by abrasion) reddish-brown; apices obtusely truncate, rounded over exterior angle. *Legs* stout, black irregularly blotched and spotted with white pile, densest on lower surface, externally with buff towards extremity of tibia; tarsi with grey clothing. *Under surface* spotted with grey and buff; sexual clothing yellow-buff.

Long. 24 mm.; lat. 8 mm.

Southern Cross (H. W. Brown).

Holotype (unique) in Australian Museum, Sydney. (K67664).

A very distinctive insect unlike any other member of the genus known to me. The dense pilose clothing and white lateral stripe should serve to identify it.

Penthea vermicularia Don.—Salmon Gums.
Two specimens very much larger than any I have previously seen, but otherwise agreeing closely with this species.
Penthea nigrina Blkb.—Salmon Gums.
Penthea tigrina Blkb.—Lake King.
Penthea ? solida Pasc.—Marvel Loch.

Corrhenes glauerti, sp. nov.

(Fig. 11.)

Very robust, brown, densely clothed with woolly pile of mixed grey and brown varied with small black spots.

Head large, broad, densely clothed with woolly grey and brown pile interspersed with long erect hairs; eyes small, strongly emarginate, black, finely granulate, upper lobe much reduced, constriction linear; median sulcus shallow, narrow; vertex with a few very large punctures; antennal bases glabrous, nitid. Antennae much shorter than body, reaching to apex of hind femora, sparsely clothed with grey pubescence concentrated at bases of joints, apices glabrous; joint 1 stout, apically dilated, with grey pubescence, apex in front glabrous, strongly punctate; joint 3 as long as 1; remainder much shorter, progressively decreasing in length to apex; 1–5 with profuse erect hairs, in remainder confined to several erect apical bristles. *Prothorax* broad, almost parallel-sided, contracting slightly to base, with two strong, pointed lateral tubercles just behind apical margin; a transverse band of grey pile covering anterior third, base pilose, but less dense, and darker; disc with numerous small nitid tubercles projecting through the brownish pile which lies in the depressions between them; the whole of prothorax with numerous long erect grey hairs. *Scutellum* small, rounded, black, with two fine pilose transverse white lines. *Elytra* slightly wider than prothorax at base, gradually broadening to about three-quarters, then contracting roundly to apex; apices broadly rounded; entirely clothed with dense woolly grey pile mixed with brown and varied with numerous small round black or infuscate spots, the whole with very numerous erect whitish hairs; basally with numerous small rounded glabrous nitid tubercles projecting through the pile and tending to be arranged in short longitudinal rows; a highly nitid glabrous longitudinal ridge, 1 mm. long, on suture close behind scutellum; suture brown. *Legs* short, stout, black, densely clothed with short, close pale-grey pile, that on front of middle tibiae brown.

Under surface densely clothed with reddish-brown pile (recumbent on abdominal segments, woolly, semi-erect on sterna), mixed with long erect white hairs.

Long. 19 mm.; lat. 7 mm.

Bulong.

Holotype (unique) in Western Australian Museum. (30–886.)

This exceedingly striking species is by far the largest in the genus and quite unlike any of its congeners. The strongly raised nitid line on the suture below the scutellum is a remarkable feature. The glabrous area upon the front of the apex of the basal joint of the antenna does not appear to be due to abrasion, since it is identical on both antennae, and the line of demarcation between glabrous and pubescent areas is oblique and very sharply defined.

Named for Mr. L. Glauert, Curator, Western Australian Museum, to whose kindness and co-operation I owe the opportunity of examining this interesting collection and describing those new species which it contains.

THE REPRODUCTIVE ORGANS OF *GEOPLANA SANGUINEA* MOSELEY.

By Marion L. Fyfe, M.Sc.
Department of Zoology, University of Otago, N.Z.

(Figure 1.)

Introduction.

In a description of New Zealand land planarians Dendy (1896) identified several specimens as *G. sanguinea*, which he considered had been introduced into New Zealand from Australia, where it is endemic. Nevertheless, Dendy was a little doubtful of his identification, as he goes on to say: "There is some difficulty in distinguishing between this species and *G. triangulata* var. *australis*."

In a collection of New Zealand land planarians received on loan from the British Museum for the study of the internal anatomy there was one specimen collected at Invercargill, N.Z., and labelled by Dendy *G. sanguinea*. From its internal structure this specimen proved to be an immature *G. triangulata* var. *australis*, now *Artioposthia australis*. In order to compare this with the real *G. sanguinea* the writer applied for material to the Director of the Australian Museum, Sydney, and was kindly given a selection of specimens of that worm.

Material.

G. sanguinea has a wide distribution all over eastern and southern New South Wales, Victoria and Tasmania, and specimens were chosen from four localities which were widely separated so as to give a fair idea of any variations in the local specimens and their geographical range. Longitudinal sagittal serial sections were cut and stained in borax-carmine and picro-indigo-carmine and from these a reconstruction of the internal anatomy was made. The result was as follows: No. W.1820 (part) from Tasmania had no reproductive organs; No. W.2151 from Blackheath was immature, having simple male and female ducts but no genital pore; No. W.2152 (part) from near Gosford had all the essential reproductive organs, though these were not so mature as in the two specimens No. W.2196 (part) from Victoria. The worms with immature reproductive organs were smaller than the mature ones, but the general structure and arrangement of the organs was the same throughout.

External Characters.

According to Moseley (1877) the dorsal surface is "a uniform light red which is lighter on the under surface of the body; length of living worm, 70 mm.". Since this was written, von Graff (1899) has included in this species *G. rubicunda* Fletcher and Hamilton (1888) and *G. alba* Dendy (1891). This allows for a wider variation in colour and size, as, for example, Dendy has found specimens of *G. alba* about 100 mm. in length, and Spencer (1891) in describing *G. alba* says: "Specimens vary in colour from almost white to orange, and sometimes brown and grey."

A faint dorsal median stripe has been described for some specimens, but Dendy (1891) says that there are no stripes in *G. alba* and there were no stripes on the specimens of *G. sanguinea* examined by the writer.

The mouth and the genital pore are in the usual position. In a specimen of 54 mm. length the mouth was 36 mm. and the genital pore 42 mm. from the anterior end.

The eyes are not numerous and are arranged in a single row across the anterior end with a few scattered ones down the sides.

Reproductive Organs (Fig. 1).

The reproductive organs are very different from those of *Artioposthia australis*, being of the typical *Geoplana* type. The genital pore (*g.p.*) opens into a common atrium (*at.*) which is separated from the male atrium (*m.at.*) by a muscular flap (*fl.*). Paired ovaries lie in the usual ventral anterior position, and from these the two oviducts (*od.*) pass back and join before entering the glandular canal (*g.c.*). This is composed of two parts—a proximal part lined with gland cells which pour their secretion into the cavity, and a distal part into which open numerous ducts of the shell glands (*sh.*) situated in the surrounding parenchyma. The glandular canal widens into the common atrium without any special papilla. A simple glandular sac (*g.s.*) opens into the common atrium just inside the genital pore on the same side as the glandular canal. This sac is lined with gland cells which produce masses of a thick secretion filling the whole of the sac as well as a large part of the female atrium. It does not appear to have the function of a bursa copulatrix, which is a receptacle for sperms at copulation and therefore is generally empty; moreover, the bursa is, as a rule, more closely related to the oviduct, and very often lies between the oviduct and the penis bulb. The glandular sac, on the other hand, is a sac for producing large quantities of secretion, and its function would appear to be related to cocoon formation, especially as its development lags behind that of the other reproductive organs. An immature worm with simple ducts and closed genital pore has no such sac; an older worm with well-developed glandular canal and seminal vesicle has, in the position of the sac, a narrow outpushing of the atrial wall with no contents. Only in the fully mature worm is any secretion found in the sac and atrial cavity.

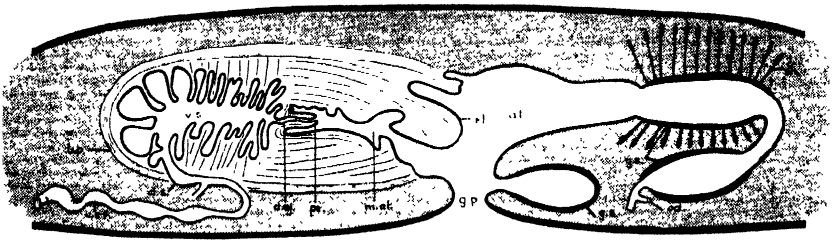

Figure 1.
Diagrammatic longitudinal section of *Geoplana sanguinea* Moseley. *at.*, common atrium; *b.p.*, penis bulb; *d.ej.*, ejaculatory duct; *d.s.*, seminal duct; *fl.*, muscular flap; *g.c.*, glandular canal; *g.p.*, genital pore; *g.s.*, glandular sac; *m.at.*, male atrium; *od.*, oviduct; *pe.*, penis papilla; *sh.*, shell glands; *v.s.*, seminal vesicle; *v.s.f.*, false seminal vesicle.

The testes lie in the usual ventral position and extend from behind the ovaries to the mouth. Each vas deferens is expanded in the region of the pharynx into a false seminal vesicle (*v.s.f.*) which, as it nears the penis bulb (*b.p.*), narrows to form a seminal duct (*d.s.*) with thick walls of circular muscles and no contents. The two seminal ducts join to form a short duct entering the seminal vesicle (*v.s.*), the lining of which is very much folded and is composed of glandular cells which pour their secretion into the cavity of the vesicle. A short ejaculatory duct (*d.ej.*) leads through a short penis papilla (*pe.*) to the male atrium.

Remarks.

This planarian is characterized by the separation of the male atrium from the common atrium by a muscular flap. Both male and female ducts are very glandular and the separate glandular sac near the genital pore is a very unusual feature.

The writer records her thanks to the Director of the Australian Museum for his help in supplying information about the distribution of *G. sanguinea* and for providing the material for this paper.

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A NEW SPECIES OF TYPHLOPS FROM NEW BRITAIN.

By J. R. Kinghorn.
Zoologist, Australian Museum.

(Figures 1–3.)

Typhlops keasti, sp. nov.

Snout long, acute and vertically compressed, forming a chitinous sharp lateral edge. Rostral long, narrow, its length above being greater than its distance from the anterior level of the eyes. Nostrils large, oblique, and below the lateral margin of the snout, which is very pronounced. The nostril is nearer to the rostral than to the preocular, and its distance from the eye is equal to four times its distance from the tip of the snout. Nasal cleft joining the second upper labial, and extending beyond the nostril, but not dividing the nasal shield. There are two upper shields forming a suture with the nasal; these might be termed internasals, and they are separated from each other by the suture between the rostral and the frontonasal. The frontal joins the frontonasal and the parietal, these shields and the supraoculars being subequal in size. There are seven scales bordering the parietals and the supraoculars. The preocular is the largest shield on the snout; it forms a very narrow suture with the ocular, and a wide suture with the prefrontal. The ocular is oblique, and is much broader above than at the junction with the preocular; it is separated from the upper labials by two rows of subequal scales. The scales are in 32 rows round the centre of the body. The total length is 285 mm., and the diameter of the body at the centre is 5 mm. The tail terminates in a very hard, thorn-like spine.

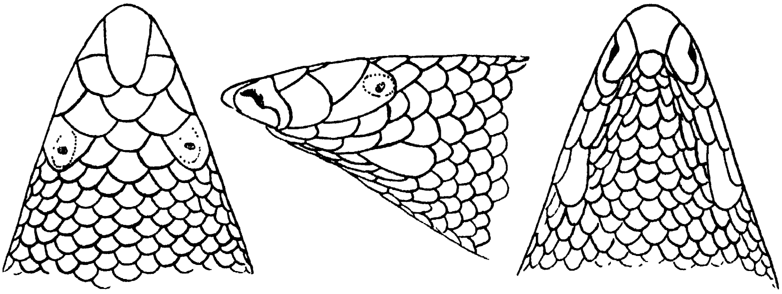

Figure 1.
Typhlops keasti Kinghorn.

J. R. Kinghorn, del.

Colour (in spirits).—Greyish above, yellowish below, the tail spine being black.

Locality.—Jacquinot Bay, New Britain. Described from a single specimen collected in June, 1945, by Sergt. J. A. Keast, A.I.F., now a member of the Museum staff. Holotype No. R.12856, in the Australian Museum.

Affinities.—*T. keasti* is allied to *T. solomonis* Parker,[1] and in a lesser degree to *T. infralabialis* Waite,[2] both from the Solomon Islands, and the figures of these are given here for comparative purposes. It will be noted that whilst all three species have very pointed snouts, that of *T. keasti* is very much longer than either of the others. *T. infralabialis* has twenty-six rows of scales round the body, and the nasal cleft arises from the first upper labial, whilst in *T. solomonis* and *T. keasti* the cleft arises from the second upper labial, and in each the scales are 32 in number.

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[1] *T. solomonis* Parker, *Bull. Mus. d'Hist. Belg.*, Tome xv, 60, 1929, p. 4, fig.

[2] *T. infralabialis* Waite, *Rec. South Austr. Mus.*, i, 1, 1918, pp. 35-36, fig. 25; and Kinghorn, Herp. Sol. Is., Rec. Aust. Mus., xvi, 3, p. 141, fig. 15 (after Waite).

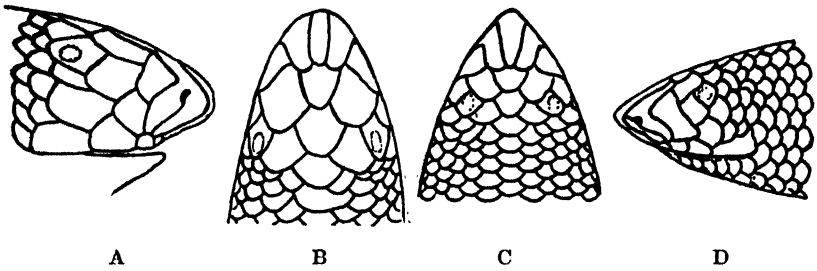

Figure 2.
A-B. *Typhlops solomonis* Parker. C-D. *Typhlops infralabialis* Waite.
J. R. Kinghorn, del.

In describing *solomonis* Parker immediately recognized the extraordinary grouping of the head shields, and he wrote: "It is impossible to homologise the numerous small head shields of the ocular region, and it is only by a figure that their disposition can be appreciated."

I agree with Parker and, in describing *keasti*, used some terms not generally associated with head shields of the genus *Typhlops*. The accompanying figures show that I refer to the upper pair of shields in front of the oculars as prefrontals, instead of supraoculars, the term preocular being restricted to the lower pair, which are by far the largest of the head shields. The complete division of the nasals, as illustrated, leaves two courses open: the posterior section may be described as either postnasals or internasals, and I have considered the latter more appropriate. The shield adjoining the rostral in *keasti* is referred to as frontonasal, then follows the frontal between the eyes, bordered by the small shields referred to as supraoculars. This leaves the parietal area with but a single shield, thereby eliminating the "interparietal" commonly referred to in other species. With only one specimen I am not in a position to examine the underlying cranial characters in association with the head shields, but I feel sure they would support the terminology I have adopted for this species. Actually the

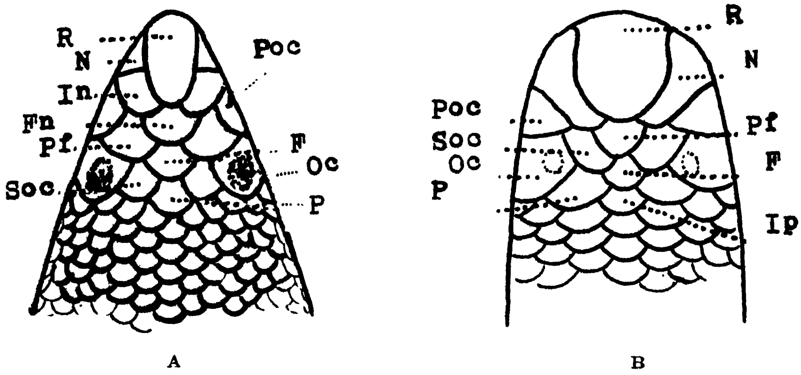

Figure 3.
Terminology of the head shields as applied to *Typhlops keasti* (A) and a normal species of *Typhlops* (B). R., Rostral; N., Nasal; In., Internasal; F., Frontal; Fn., Frontonasal; Pf., Prefrontal; Poc., Preocular; P., Parietal; Soc., Supraocular; Ip., Interparietal; Oc., Ocular.
J. R. Kinghorn, del.

terminology of the head shields of many of the species of *Typhlops* is very perplexing, and their disposition is certainly not constant, suggesting that only by figures can the essential characters of a description be appreciated.

Since going to press a new species, *T. bergi*[3] J. A. Peters, has been described from Sergi Point, New Georgia, Solomon Islands.

This interesting form agrees with *T. infralabialis* Waite, in having only 26 rows of scales, whilst the profile and general disposition of the head shields indicate a close relationship to *T. solomonis* and *T. keasti.*

Peters also finds that the nomenclature of certain head shields is confusing, as he refers to the single preocular being separated from the orbital area by a posterior ocular. Parker refers to two superposed preoculars separated from the orbital area by a scale of uncertain homology, but apparently derived from the ocular.

It would appear that a modification of Peters' statement might be accepted, and I suggest that the preoculars be indicated as 1 + 2 or 1 + 1 as the case may be, otherwise the anterior shields must be regarded as loreals, being situated in the loreal region.

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[3] *T. bergi* Peters, *Occ. Papers, Mus. Zool. Mich.*, No. 508, Feb. 16, 1948, pp. 1-3, figs. 1-2.

STUDIES IN ICHTHYOLOGY. No. 13.*

By Gilbert P. Whitley, F.R.Z.S.
Ichthyologist, The Australian Museum, Sydney.

(Figures 1–11.)

Family LEPTOCEPHALIDAE.

Genus **Fimbriceps** Whitley, 1946.

Orthotype, *F. umbrellabia* Whitley.

A remarkable genus of conger eels with skinny filaments protruding from the snout and over the eyes. Top of snout not swollen. Lips not turned upwards into a flange, but overhanging and with well developed labial bones. Anterior patch of teeth of upper jaw exposed when mouth is closed. Fine teeth on jaws and vomer, none much enlarged. Caudal pointed. Colour plain, brownish.

This combination of characters distinguishes *Fimbriceps* from all the fifty or so nominal genera of congers.

Fimbriceps umbrellabia Whitley, 1946.

Fimbriceps umbrellabia Whitley, Austr. Mus. Mag., ix, 2, 1946, p. 62, fig.

Head (17 mm.) 6·5, depth (7) 16. preanal length (39) nearly 3 in total length (112). Eye (4·4) 3·8, snout (5) 3·4, pectoral (6) 2·8 in head. Head conic, rather bulbous posteriorly. Eyes large, rounded pyriform. Interorbital very narrow.

About 9 or 10 branchiostegal rays each side. No jugostegalia. Opercular elements discernible through skin. Some mucus canals from eye to near gill-opening and down front of operculum. Gill-slits moderate openings before pectoral fins, directed downwards and backwards, and sealed below across a broad isthmus. Mouth reaching below posterior half of eye. Upper jaw the longer. Two keels along chin. Bands of fine pointed teeth on jaws, smaller bluntly conic ones cross roof of mouth, this vomerine patch apparently not extending backward to eye but tapering to cease before the free, well-developed tongue. The anterior teeth in upper jaw are slightly enlarged and form a group exterior to the mouth-opening. Anterior teeth of lower jaw deflected slightly outwards; a couple of posterior teeth in upper jaw are antrorse.

I am unable to distinguish the nostrils, but they are probably before the eye and over the lip anteriorly as usual in congers. The upper lip is not turned upwards into a flange. There are two overhanging flaps of skin over upper jaw, the uppermost simple, the second scalloped and lying over the lips, which are supported by well-developed labial bones.

The snout is not swollen, but pointed, and bears several forwardly directed filamentous processes about one millimetre long. Two similar processes over eye, and some small ones below sides of lower jaw.

Body elongate, tapering, compressed, naked. Tail attenuated, nearly twice as long as rest of fish. Doubtless through abrasion during trawling, much of the skin is missing and the lateral line structure cannot be made out, but there are no white-spotted pores as in some congers.

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* For No. 12 see Records of the Australian Museum, Vol. xx, Part 4, March, 1939, pp. 264-277, figs. 1-3.

The author is indebted to the Council of the Royal Zoological Society of New South Wales for the loan of blocks from his forthcoming "Fishes of Australia" used in Figures 2, 4, 5, 7 and 9 of the present paper. All figures have been drawn by the author and, unless otherwise stated, the line accompanying each represents one inch.

Dorsal fin originating behind head, over adpressed pectorals. The (a-d) percentage is 14·22. Anal beginning behind vent. Both fins of many short, spaced rays, joined to the pointed caudal, which is 2 mm. long. Pectorals pointed.

Colour (in alcohol) dark brownish above, yellowish to silvery below. Some dark brown spots on cranium and operculum and smaller infuscations along upper jaw and before eye along snout. Fins pale, without black margins.

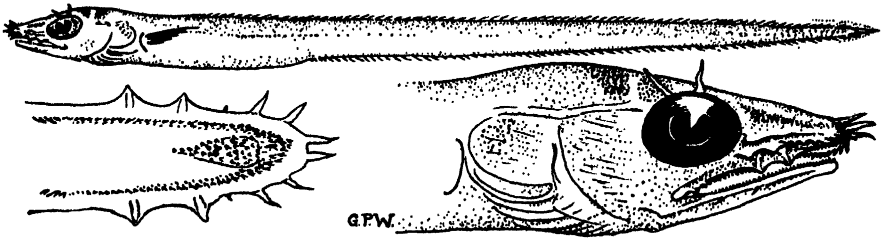

Figure 1.—Fringe-nosed Conger, *Fimbriceps umbrellabia* Whitley. Holotype from off Broughton Id., New South Wales.

Described and figured from the larger of two examples, 90 to 112 mm. long (4½ ins.). Austr. Mus. regd. no. IA.6895 (holotype and paratype).

Loc.—Three miles off Broughton Island, New South Wales; seined in 45 to 50 fathoms; 29 May, 1936. Collected by Mr. Melbourne Ward.

Another example (IA.8013) was obtained by Dr. D. L. Serventy from the stomach of a Tuna (*Thunnus maccoyii*) at Twofold Bay, N.S.W., and was partially digested.

Bassanago, gen. nov.

Orthotype, *Bassanago bulbiceps*, sp. nov.

A genus of deep-sea conger eels with the eyes large, supero-lateral; anterior nostrils, with tubes, below front of snout; cleft of mouth extending to middle of eye. No upper lip developed. Lower jaw much shorter than upper. Teeth small, conic, in bands on jaws and on vomer; anterior intermaxillary teeth exposed when mouth is closed. Head much shorter than trunk. Vent anterior to middle of length. Lateral line not branched. Dorsal originating over anterior part of pectoral. Coloration plain, mostly pale.

Differs from *Bathycongrus* Ogilby, 1898, in proportions of head and trunk and in having a short, bulbous snout. *Rhynchoconger* Jordan and Hubbs, 1925, is diagnosed as having the "premaxillary" patch of teeth larger than the vomerine patch, and my genus also differs in having a blunter snout, different dorsal origin and colouring of fins. From all other genera in the family the novelty is distinguished by the combined characters in the diagnosis above.

Bassanago bulbiceps, sp. nov.

Diagnosis.—A deep-sea conger eel which differs from all other Australasian species by having the dorsal fin arising above the pectoral bases; the snout is broad and swollen.

Description.—Head (38 mm.) 6·8, depth (13) 19·8 in total length (258). Depth of body equal to its width (13). Eye (8) 4·7, snout (10) 3·8, gape (11) equals pectoral (11) 3·4, interorbital (3) 12·7, gill-opening (6) 6·3 in head. Distance between gill-slits, below, 9 mm. Snout to dorsal origin 39. Preanal length about 100. Tail 158. Level of dorsal origin to that of anal 61; (a-d) percentage = 23·6%.

Head swollen, bulbous, spongy, inflated at gills. Snout bluntly truncate, overhanging mouth; without fleshy processes but with some microscopic papillae. Gape broader than long, rictus barely reaching below posterior half of eye. No flange or fold on upper lip, which continues from mouth to skin of head without interruption. Lower lip developed. Anterior nostrils short tubes opening downwards below snout. Posterior nostrils rather large, just before middle of eye. Bands of small conic teeth on jaws, intermaxillaries and vomer. Anterior teeth external to mouth. The vomer teeth do not extend back as far as eye. Ten branchiostegal rays can be counted through the skin.

Body cylindrical anteriorly to strongly compressed posteriorly. Lateral line conspicuous, not branched, the numerous pores joined to form a continuous channel from head to tail. Myocommas conspicuous except posteriorly; there appear to be at least 150. Vent large, just before anal fin.

Dorsal originating over posterior part of pectoral base, becoming much higher posteriorly and confluent with the long rounded caudal. Pectorals small, pointed, adipose.

Colour, after long preservation, straw-yellowish. Eyes, gill-region and viscera bluish. Vent black. Unpaired fins with broad median dusky (brownish or blackish) area, marginally whitish. Minute brown infuscations on top of head and body.

Described and figured from the unique holotype, a specimen 258 mm. or nearly 10¼ inches in total length.

Loc.—Eastern slopes of Bass Strait, Victoria; 200 fathoms. F.I.V. "Endeavour", 11 December, 1913. Registered no. E.4633.

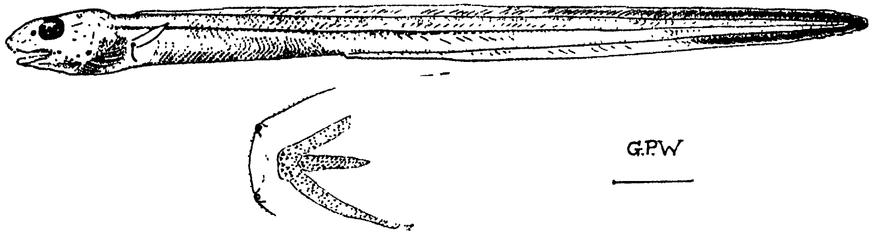

Figure 2.—Swollen-headed Conger, *Bassanago bulbiceps* Whitley. Holotype from east of Bass Strait. Also nostrils and teeth of upper jaw.

Family MURAENIDAE.

Fimbrinares, gen. nov.

Orthotype, *Fimbrinares mosaica*, sp. nov.

A large reef-eel or moray which differs from other Muraenidae in having the anterior nostrils in short tubes and the posterior nostrils with conspicuous tassel-like exterior fringes. The intermaxillary teeth are curved, depressible fangs in 2 to 3 rows, and there are more than 25 teeth along each side of jaws.

Otherwise much as in *Gymnothorax* of authors, *Aemasia* Jordan and Snyder, 1901, and *Enchelycore* Kaup, 1856.

Fimbrinares mosaica, sp. nov.

Head (150 mm.) 6·8, depth (86) 12 in total length (1033).

Snout to vent (491) less than tail (542). Eye (11) 13·6, snout (32) nearly 4·7, gape (71) 2·1, interorbital (20) 7·5, gill-opening (11·5) 13·9 and width of body (50) 3 in head.

Snout and jaws long, top of head not much swollen. Eye small, covered by skin, subequal to gill-opening. Interorbital broad, flat. Anterior nostrils with short tubes. Posterior nostrils rimmed with conspicuous tassel-like superior fringes, formed by numerous laminae, above and before eyes. Lips entire. Gape reaching well beyond eye.

Mouth not completely closing because of the great development of the long, entire, subulate teeth. The latter are strong, depressible fangs which occur in the jaws as an outer row of smaller teeth with an inner single to double row of longer fangs. Intermaxillary teeth in one to three rows, their bases extending back to level of eye. No median vomerine teeth behind eye-level. No molars. Throat furrowed.

Body deep and rather robust, becoming compressed and blunt towards end of tail. Skin smooth and slimy. Anus small with small separate urinogenital pores, and no radiating plicae, situated in anterior half of fish. Vertical fins fairly well developed as adipose folds. The dorsal origin is before level of gill openings, its height only about one-fifth or one-sixth of body-depth, except towards end of tail, where it is about one-half same. Anal similar to but lower than dorsal, originating a short distance behind vent. Caudal embedded in adipose tissue round end of tail.

Colour in formalin pearly greyish, widely reticulated with a series of open, chain-like, dark purplish-brown markings over body and fins, tending to form about 24 cross bands. The chain-like network breaks up into marbling or mottling in some places, becoming more diffuse or irregular on head and breast, where the pearly ground colour predominates. No dark blotch at corner of mouth or at gill-opening. Nostril fringes yellow.

Described from the unique holotype, 44 inches long. Austr. Mus. regd. no. IA.3926.

Loc.—Caught on the ocean side of Point Banks, near Botany Bay, New South Wales, in 5 feet of water amongst rocks by Mr. H. Warner on 23rd June, 1929; it took 1¼ hours to land.

Distinguished from other reef eels by its fringed posterior nostrils and numerous intermaxillary fangs.

Genus **Lycodontis** McClelland, 1844.

Lycodontis longinquus, sp. nov.

Head (91 mm.) 7·9, depth (40) 18 in total length (720). Snout to vent (342) shorter than tail (378). Eye (8) 11·3, snout (15) 6, gape (33) 2·7, interorbital (10) 9·1, gill-opening (7) 13, and width (28) 3·2 in head.

Top of head slightly swollen. Snout blunt, rather long. Eye covered by skin, larger than gill-opening. Anterior nostril with tube; posterior pore-like near top of eye. Lips minutely papillate. Gape reaching well beyond eye, mouth not completely closing. Spaced, compressed, entire teeth in single rows on jaws and vomer. Intermaxillary teeth fang-like, not depressible like the vomerine fangs. No molars. Throat furrowed.

Body elongate, compressed, particularly at end of tail. Skin smooth and tough. Anus large, with radiating plicae, in anterior half of fish. Vertical fins developed, the dorsal originating over head and continuing back as a low fold and becoming higher over posterior part of tail. Anal fin similar, commencing behind vent. Caudal reduced to a few short rays sandwiched between posterior dorsal and anal rays.

Colour in alcohol fairly uniform dark chocolate brown, with some ill-defined traces of lighter brown mottling. Eye greenish-silvery, surrounded by dark brown ring. Gill-opening yellowish. Dorsal, anal and end of tail blackish posteriorly. No special colour-markings.

Described from the unique holotype, 720 mm. or 28 inches long, from north of Mackay, Queensland (Mr. Charles Volskou). Austr. Mus. regd. no. IA.6953.

Characterized by its dull brownish coloration, the single rows of compressed fangs, and by its proportions.

Family SERRIVOMERIDAE.

Bertinulus, gen. nov.

Orthotype, *Oxystomus hyalinus* Rafinesque, Ind. ittiol. Sicil., May, 1810, pp. 49 and 62, pl. = *Bertinulus hyalinus.*

New name to replace *Oxystomus* Rafinesque, 1810 (*loc. cit.*), which is preoccupied by *Oxystomus* Fischer de Waldheim, 1803, a genus of mammals, and *Oxystoma* Dumeril, 1806 (Coleoptera) *non* Blainville, 1825 (Mollusca). The fish genus has generally been regarded as a juvenile Snake Eel (*Leptognathus*) but Bertin (Comptes Rendus Acad. Sci. Paris, cc, 1935, p. 1878) has recently demonstrated its distinctness and alliance with the Serrivomeridae.

Two species: *Bertinulus hyalinus* (Rafinesque) and *Bertinulus danae* (Bertin).

Family SYNGNATHIDAE.

Maroubra, gen. nov.

Orthotype, *Maroubra perserrata*, sp. nov.

Axis of the head in line with that of the body, which is slender, not compressed. Eyes not prominent. Snout ridged, broader than deep, not spiny, about half the head. The entire superior rostral ridge rises gently to the forehead. Operculum with transverse keel, curved, concave side upwards, with radii. Occiput with entire crests. Trunk heptagonal, tail tetragonal, equal to about half total length. Shields with edges prominent, entire, with a backwardly directed spine on each crista of each annulus. No cutaneous appendages apparent. Prenuchal and nuchal shields present, also intermedial scutella. Disposition of body-ridges as in no. 7 of Duncker's scheme (Mitt. Zool. Mus. Hamburg, xxxii, 1915, p. 14, fig. 7), viz., median cristae of trunk continuous with superior cristae of tail, inferior cristae of trunk and tail continuous, superior cristae of trunk and tail discontinuous. Broodpouch probably subcaudal.

Dorsal fin mostly on tail, its base not elevated. Pectorals well developed. Anal obsolete. Caudal very small, the tail not prehensile.

The spiny ridges to the body and tail-rings and the disposition of the cristae distinguish the new genus from other Syngnathidae, as well as the formulae given below.

Maroubra perserrata, sp. nov.

General characters as described for genus.

D. 21, A. O, P. circa 18, C. 6. Rings 18 + 26 = 44. Subdorsal ann. 1 + 5.

Head (9 mm.) 6·6, depth (2·5) 24 in total length (60). Snout (4·5) half head and greater than postorbital (slightly less than 3), which is about twice eye-diameter (1·5). Length of dorsal base (6) 1·5 in head.

Orbits not prominent. Interorbital concave, transversely striate. Rostrum with thin, elevated, entire ridge, separated by a pair of spines from the supraorbital ridges. Curved nuchal ridges.

Preanal length 31, postanal 29 mm. Dorsal ridges of trunk and tail discontinuous. Median ridge of body connecting with superior ridge of tail. Inferior ridges of trunk and tail continuous. Ventral carina present. Each body-ridge forming a sharp, obliquely receding spine on each annulus. Oval scutella present between the plates.

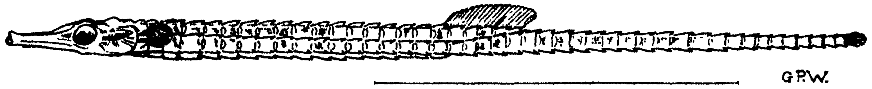

Figure 3.—Sawtooth Pipefish, *Maroubra perserrata* Whitley. Holotype from Maroubra, New South Wales.

No broodpouch in this specimen, but the organ would doubtless be subcaudal since the strongly developed ventral carina would not permit it to occur below the body. No cutaneous appendages. Dorsal base not elevated.

Colour in alcohol, yellowish with darker brown or reddish markings extending along middle of head and sides. Throat plain. Eyes bluish.

Described and figured from the unique holotype, a specimen 60 mm. or 2⅜ inches long. Austr. Mus. regd. no. I.12659.

Loc.—Maroubra Beach, near Sydney. New South Wales; Allan R. McCulloch, Sept., 1912.

Distinguished from other pipefishes by the formulae given above, the disposition of the body-ridges, and the well-developed spines on each ring.

Pugnaso, gen. nov.

Orthotype, *Syngnathus curtirostris* Castelnau, 1872.

Differs from the much larger, typical *Syngnathus* (*acus* L.) in having the snout very much shorter and deeper, fewer dorsal rays (20 to 24 instead of 36 to 45), fewer pectoral rays, and brood-rings 16 instead of 25 to 28, besides minor details. No opercular ridge. For full description and figure, see Waite and Hale, Rec. S. Austr. Mus., i, 1921, p. 300, fig. 42.

Filicampus, gen. nov.

Orthotype, *Syngnathus superciliaris* Gunther, 1880.

Differs from *Syngnathus* in having a conspicuous filament over eye, fewer dorsal rays, fewer tail-rings, much shorter snout, and in proportions generally.

Mitotichthys, gen. nov.

Orthotype, *Syngnathus tuckeri* Scott, 1942.

Snout shorter than in true *Syngnathus* and with a median crest. Rings 23 + 42. No opercular keel, only radiating striae.

Dorsal fin situated mostly over body, with more rays (35) than most Australian pipefishes.

Broodpouch on 12 rings (instead of 25 or more as in true *Syngnathus*).

Larvicampus, gen. nov.

Orthotype, *Festucalex* (*Campichthys*) *runa* Whitley, Austr. Zool., vi, 1931, p. 313 = *Larvicampus runa.*

D. 14. Rings 13 to 14 + 46 to 47. Subdorsal rings 3.

Snout very short, tilted upwards. No opercular keel. Ridges rather obscure, median ones continuous with inferior cristae of tail. Rings with a minute tubercle at their hinder ends. Minute tentacles on body, broodpouch and tail. Length less than four inches.

Differs from true *Campichthys* (*tryoni*) in having more than 45 tail-rings instead of about 35, fewer dorsal rays, snout very short, and median cristae continuous with inferior caudal ones.

Stipecampus, gen. nov.

Orthotype, *Ichthyocampus cristatus* McCulloch and Waite, Rec. S. Austr. Mus., i, 1918, p. 40, fig. 26 = *Stipecampus cristatus.*

The genotype of *Ichthyocampus* Kaup, 1853 [=*Hippichthys* Bleeker, 1849], is *Syngnathus carce* Hamilton Buchanan (Acc. Fish. Ganges, 1822, p. 13), an Indian species which differs so much from the South Australian *cristatus* that the latter cannot be maintained in the same genus. A Calcutta specimen of *carce* differs from *cristatus* as follows:

A. Snout subequal to postorbital, with three ridges above. Interorbital concave. About 23 dorsal rays. Annuli 16 + 39 or 40. Subdorsal rings 6, all on tail. Head about 2 in trunk .... *Hippichthys* (*carce*)

AA. Snout much shorter than postorbital, with elevated crest. Interorbital flat, with median ridge. More than 25 dorsal rays. Annuli 19 to 20 + 40 to 41. Subdorsal rings 1 to 2 on trunk + 5 on tail. Head about 3½ to more than 4 in trunk .. *Stipecampus* (*cristatus*)

Hypselognathus, gen. nov.

Orthotype, *Histiogamphelus rostratus* Waite and Hale, Rec. S. Austr. Mus., i, 1921, p. 303 = *Hypselognathus rostratus*.

The name *Hypselognathus* was suggested in manuscript by the late E. R. Waite as long ago as 1919 but has not hitherto been published. The type-species is readily distinguished from all the species of *Histiogamphelus* by the extraordinarily long snout, and increased number of dorsal rays (32 to 35 instead of 23 or 24) and tail-rings (44 instead of 27 to 36). Subdorsal rings 1 to 3 + 7 to 8. Upper part of snout raised into a knife-like ridge. Young with anterior opercular keel and serrated tail-ridges, but these characters disappear with age.

Histiogamphelus maculatus robensis, subsp. nov.

D. 24, P. 14, A. 3, C. 8. Rings 20 + 36. Subdorsal annuli 4½ + 3. Female, so no brood-rings.

Head (11·3 mm.) 3·4 in length of trunk (39) or 8·3 in total length (94·5). Eye (2) more than 2 in snout (4·3) which is 2·6 in head and slightly less than postorbital (5). Trunk about two-thirds tail (55). Caudal length equal to snout. Pectoral length, 3 mm. Depth 3·3 mm. below dorsal fin, much more than width (2·5).

Rostral crest roundly sloping from behind lips to a slight dip before attaining its greatest height over posterior half of snout, after which it descends gradually to between two posteriorly divergent ridges which cease on the reticulated interorbital which is sunken between the supraorbital ridges which are distinct from the rostral. A prenuchal and two nuchal scutes, not joined to rostral crest which ceases above front of eyes. No median dorsal ridge. A simple, slightly curved opercular keel (concave side downwards) and forty or more radiating ridges. The ridge defining the upper margin of the snout below the rostral crest slopes down towards middle of eye or little below that level. The supraorbital ridges touch the profile.

Dorso-lateral body-ridges ending on each side of dorsal base, on second tail-ring, not continuous with dorso-lateral tail-ridges which extend to upper part of last body-ring, over but separate from the free end of the median body-ridge. Ventro-lateral ridges of body continuous with inferior tail-ridges. Ventral carina on trunk.

Dorsal base elevated anteriorly, less so posteriorly. The dorsal rays are difficult to count but do not appear to exceed 24. Anal minute. Caudal lanceolate.

Colour in alcohol dark brownish with irregular darker markings. Dark chocolate base to dorsal rays. Caudal blackish. Pectoral brown basally, rest yellow. Some rings with dark brown spots and often a spot at middle of ring on ridges.

Described from the holotype of the species, a female 94·5 mm. or 3·7 inches long, kindly lent for the purpose by Mr. H. M. Hale, Director of the S. Australian Museum, Adelaide, where the specimen is regd. no. F.2611.

Loc.—Near Robe, south-eastern South Australia; Mr. Bruce Hendon, 17 Feb., 1947.

The new subspecies seems closest to *H. maculatus* Hale, 1939, which, however, has notch further back in rostral crest, fewer tail-rings and pectoral rays, no opercular keel, less sculpture and different proportions. Also similar to *H. gallinaceus* Hale, 1941, but comparatively stouter in build, with longer caudal fin, rostral crest not so elevated and not continued beyond interorbital, supraorbital touching profile, and snout longer. *H. cristatus* (Macleay, 1881) has only 18 + 27 rings, according to the original description; the type has decomposed. *H. briggsii* McCulloch, 1914, the genotype, has a high concave rostral crest, no opercular keel, and shorter caudal fin. *H. meraculus* Whitley, 1948, has caudal fin much shorter than the rather long snout and different head-proportions.

Genus **Parasyngnathus** Duncker, 1915.

Parasyngnathus Duncker, Mitt. Naturh. Zool. Mus. Hamburg, xxxii, 1915, pp. 14, 29 and 79. Orthotype, *Syngnathus argyrostictus* Kaup, Cat. Loph. Fish. Brit. Mus., 1856, p. 33 *ex* Kuhl and van Hasselt MS., Java.

Parasyngnathus wardi, sp. nov.

D.22. A.2. P.15. C.9. Rings 14 + 36. Subdorsal 1 + 5.

Head (10 mm.) 8·4, depth (4) 21 in total length (84). Snout, 4·5 mm.; eye, 1·5; postorbital, 4; width of body, 2·3; preanal length, 29; postanal, 55; length of dorsal base, 6·5; length of caudal fin, 3·3.

Snout in line with axis of head and body, sculptured laterally and surmounted by a thin, entire, gently rising keel which ceases between the eyes and is separate from supraorbital ridges. Prenuchal and nuchal crests present. Operculum crossed by a straight keel with fine, interrupted radii. Eyes not prominent, each preceded by a spine, otherwise no spines on head.

Body heptagonal, rather deep; tail tetragonal. Superior ridges of trunk and tail discontinuous. Medial body ridge dipping and just joining tail ridge over vent. Inferior ridges of body and tail continuous. Ventral carina present. Ridges well marked, but without spines or appendages. Scutella present. None of my specimens has a brood-pouch but this organ would doubtless be subcaudal.

Dorsal base not raised. Anal very reduced. Caudal small, middle rays longest. Pectorals developed.

Colour in alcohol yellowish-brown with some darker brown marblings on snout, head and body, tail and dorsal fin. Throat plain. Ventral carina with dark brown crest. Caudal with blackish central area, lighter around same.

Described from the holotype, evidently a female (as it has no brood-pouch), the largest (3¼ inches) of seven specimens. Austr. Mus. regd. nos. IB. 1911 (holotype) and 1912 (paratypes).

Loc.—Lindeman Island, Queensland; Mr. Melbourne Ward.

The six paratypes show the following variation: D.22 to 24. Rings 13 + 35 in all six. Subdorsal rings 0 to 1 + 4 to 5.

The low numbers of dorsal fin-rays and ring-counts and the more anterior situation of the dorsal fin separate the new species from *P. altirostris* (Ogilby, 1890), its nearest ally, and other species of *Parasyngnathus*. *Oxleyana parviceps* (Ramsay and Ogilby, 1886) also has a much shorter snout. Types directly compared at the Australian Museum.

Parasyngnathus howensis, sp. nov.

D.30; A.4; P.15; C.8. Rings 16 + 35, Subdorsal rings 1 + 7. Broodrings 14.

Head (9 mm.) 9·1, depth (4·2) 17·1 in total length (82). Snout, 4 mm.; postorbital, nearly 4 mm.; eye, nearly 1 mm.; width of body, 3·5; preanal length, 33; postanal length, 4·9; length of dorsal base, 10·5; of caudal fin, 2.

General characters as in *P. altirostris* and *P. wardi*, but opercular keel reduced to anterior half of operculum which has well-defined radii. Median body-ridge ending on middle of sides above vent.

Colour in alcohol pale yellow. A brown bar along snout through eye to operculum. Series of brown spots along ridges where they join rings. Ventral carina, caudal fin, and broodpouch pale yellow. Eye bluish. Throat plain.

Described from the male holotype, 82 mm. or nearly 3¼ inches long. Austr. Mus. regd. no. IA.5473.

Loc.—Lord Howe Island.

Distinguished mainly by its formulae and reduced opercular keel.

Campichthys tryoni lindemanensis, subsp. nov.

Ichthyocampus tryoni Ogilby, Rec. Austr. Mus., i, 1890, p. 56. Moreton Bay.

D.20. P.8. C.11?. Rings 14 + 40. Subdorsal rings 1 + 5.

Head (7 mm.) 12, depth (3) 28 in total length (84). Snout, 3 mm.; eye, less than 1; postorbital, nearly 4; width of body, 2·5; preanal length, 24; postanal length, 60; length of dorsal base, 7; length of caudal fin, 2.

Snout in line with axis of head and body, short, little sculptured, its superior ridge horizontal, not elevated, continuous with supraorbital ridges. Head covered by skin, nuchal crests obsolescent. Opercular keel obsolescent and with obsolescent radii (but compare remarks on variation below). Eyes small, not prominent. No spines or appendages.

Body heptagonal, the ridges rather rounded and weak, and the annuli poorly marked. None of the ridges toothed. Superior ridges of trunk and tail continuous. Median body-ridge ceasing at middle of sides before level of vent. Inferior ridges of trunk and tail continuous. Ventral carina blunt. Scutella present. A conspicuous l. lat. pore on each side of each ring. Broodpouch subcaudal, on first thirteen tail rings, with sides coalesced over embryos.

Dorsal base not raised. Anal overgrown by broodpouch. Pectoral reduced. Caudal small.

Colour in alcohol brown to dark chocolate with darker spots around orbit, on body, etc. Throat plain; a dark brown band along ventral carina. Caudal dusky with light edges. Broodpouch with dark longitudinal striations.

Described from the male holotype of the subspecies, an embryo-carrying specimen, 84 mm. or about 3¼ inches long. Austr. Mus. regd. no. IA.6134.

Loc.—Lindeman Island, Queensland; collected by Mr. Melbourne Ward from Zostera flats on the north-west side of the island, July, 1934.

Also four smaller paratypes of both sexes (regd. nos. IB.1909–1910) from same place and collector. Females are lighter brown in colour with dark brown bar from chin, through eye, and across operculum. Some have short black streaks on the body-rings. A vestigial anal fin is present. In males the median ridge unites with the inferior ridges above the vent. In females, it ends on the median line on the first or second tail-ring. A curved keel is present on anterior half of operculum, its concave edge uppermost in some specimens, but it is vestigial in others or covered with skin. Paratypes have D. 18 to 20, Rings 13 to 16 + 35 to 41, Subdorsal Rings 1 + 4 or 2 + 3, Broodrings 12.

Distinguished by the short snout, smooth head, weak rings and ridges, small pectoral and anal fins. Very near *Campichthys tryoni* (Ogilby, 1890), but differing in having the ridge on the snout submerged by skin, longer tail and more tail-rings. Ogilby's holotype has the following characters: D. 18?, A. 2 or 3, P. 8, C. 10, rings 17 + 36, subdorsal rings 1 + 4, broodpouch rings 14. Head (7 mm.) 10, depth (3) 23 in total length (70). Snout, 2 mm.; eye, 2; postorbital, 3; width of body, 3; preanal length, 24; postanal length, 46; length of dorsal base, 6; of caudal fin, nearly 2. Snout with elevated, undulating and entire edges, laterally sculptured, superior ridge, continuous with supraorbital ridges and not obscured by skin. Nuchal crests practically obsolete, merging into sculpture of vertex. Operculum with very short anterior keel and interrupted radii. Body-ridges and rings well marked. Posterior scutella elongate-lenticular. Median ridge ending on 2nd (left) or 3rd (right) tail-ring.

A series of fifteen small specimens collected by Mr. Melbourne Ward at Southport, Queensland, in October, 1937, agree with the typical southern species, having D. 17 to 20, rings 16 to 17 + 33 to 36, subdorsal rings 1 to 2 + 2 to 4, broodpouch rings 13 to 17. A ridge is developed over the snout of each.

TRIPTEROPHYCIDAE, fam. nov.

A new family of the Order Anacanthini, intermediate in some respects between Macrouridae and Gadidae, agreeing in general aspect with the former but differing in having three dorsal fins and an isocercal true caudal fin with small peduncle. The third dorsal fin is more reduced than the second dorsal of most Macrouridae, being much less developed than the anal. The single row (except anteriorly) of incisor teeth in each jaw contrasts sharply with the bands of teeth usual in the other families. The blunt snout, lack of scaly ridges on head, few-rayed ventrals, and black glandular area around and before the vent are noteworthy characters. The dorsal rays are not barbed and the small scales are deciduous and have not the sculptured spines of most Macrouridae.

One genus originally described by Boulenger as occupying "an isolated position in the Phycine group of the Gadidae, being the only one to combine a tripartite dorsal fin with a single anal".

Genus Tripterophycis Boulenger, 1902.

Tripterophycis Boulenger, Ann. Mag. Nat. Hist. (7), ix, May 1, 1902, p. 335. Haplotype *T. gilchristi* from South Africa.

Id., Boulenger, Mar. Invest. S. Africa, ii, 1904, p. 168, pl. xii.

Id., Brauer, Wiss. Ergebn. Deutsch. Tiefsee Exped. Valdivia, xv, 1, 1906, p. 275, text-fig. 171.

Id., Gilchrist, Spec. Rept. S. Africa. Fish. Mar. Surv. Spec. Rept., ii, 1922, p. 64.

Id., Barnard, Ann. S. Afr. Mus., xxi, 1925, p. 329.

Id., Weber and Beaufort, Fish. Indo-Austr. Archip., v, 1929, p. 11, fig. 4.

General characters as diagnosed for the family. Head rather bulbous, without rough ridges. Body long and tapering, with small deciduous, cycloid scales. Back elevated below second dorsal fin, which corresponds to the first dorsal fin of Macrourid fishes. A small first dorsal fin on the ascending profile and a rudimentary long-based third dorsal fin which, like the better developed anal fin, is distinct from the isocercal caudal. Anal not notched. Vent with glandular organs.

South Africa, N.W. of Sumatra, S. Australia and Victoria. About 150 to 450 faths.

Tripterophycis intermedius, sp. nov.

Head about as wide as deep, longer than wide, snout bluntly rounded to truncate, nostrils large, adjacent openings with skinny rims, but no barbels, near front of the large eye which is longer than the width of the scaly interorbital. Preorbital shallow. Most of posterior part of head with deciduous scales. No notable muciferous caverns. No spines or sculpturing on the papery skull-bones. Mental barbel short. Jaws reaching below front half of eye, subequal anteriorly. Premaxillary pedicels short and blunt. Maxilla truncate, without supplementary bone.

An even, single row of about forty fixed, compressed, incisor teeth around the outer margin of each jaw, not interrupted at symphysis, where a second row appears in the front part of each jaw. A narrow velum maxillare. No inner series of teeth. No teeth on vomer or palatines. Tongue adnate to floor of mouth. Opercles spineless, entire; preoperculum concealed beneath the skin. Some inconspicuous pores around chin and part of eye. Seven branchiostegal rays. Gill openings wide, gill membranes united across isthmus. No fold of membrane attached to first gill-arch to restrict the gill-slit. Gill-rakers slender, not tubercular, on first gill-arch (2/12 on first gill-arch of a paratype), the longest less than one-third eye-diameter. No slit behind fourth gill-arch. No pseudobranchiae.

Body much deeper than broad anteriorly and very compressed posteriorly. Except for the angularly-raised bases of the first two dorsal fins, the upper profile is almost straight from eye to top of tail; lower profile elongate-convex. Body with moderate to small deciduous scales which are mostly lacking so that it is not possible to count them.

They are apparently cycloid, without rows of spines as in Macrouridae. Lateral line inconspicuous. Belly rather swollen, with flaccid skin, which also invests some of the unpaired fins.

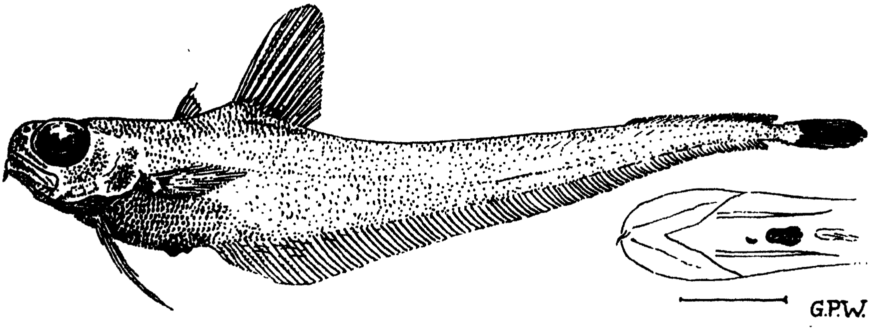

Figure 4.—Grenadier Cod, *Tripterophycis intermedius* Whitley. Holotype from Great Australian Bight. Also glandular area at vent.

Vent little advanced before anal fin, surrounded by a black area which also embraces a disc-shaped glandular area preceding the urino-genital opening. These organs are doubtless comparable with the anal glands of *Malacocephalus* as described by Hickling,[1] but they are not preceded by any naked depressed areas.

(Dissection of a paratype (IB.1727) reveals 72 vertebrae and 14 ribs. Airbladder a simple bag without horns and with elongated neck anteriorly; it ends below the 19th vertebra. Immature male. It is probable that all the specimens are immature so that the species may grow to a considerably greater size. I am unable to detect any indications of sexual dimorphism in the series before me, but some have the first dorsal rays more produced than in the type.)

Fins: D. 5/13/c.30; A. c. 100; P. 18; V. 4 or 5; C. 13 branched rays.

Three dorsal fins of weak slender rays. The first is small and originates over the pectoral rays and consists of five filiform rays, its base is half its height. The second is similar in position and form to the first dorsal of Macrouridae; its first inch-long ray has a trenchant anterior edge, without barbs; the following rays are branched, the fourth being longest. The third dorsal fin begins inconspicuously as low rays well behind the second and ceases at the caudal peduncle; it is not nearly as well developed as the anal fin which extends (without notable notch or dwarfed rays) from a little behind vent to caudal peduncle. The first five anal rays are simple, most of the remainder are branched. Pectorals pointed, the fourth ray longest but shorter than head without snout, without a peduncle. Ventrals with five filiform rays, more produced than the rays of the other fins, the third and fourth sometimes united. Caudal well developed, elongate-ovate, just separated from the dorsal and anal fins by a very short peduncle; it has thirteen branched rays and several simple external ones.

Colour (in alcohol) brownish-pink. Eyes and viscera blue. Fins pale yellowish or whitish. Brown spots on sides of head and thickly distributed below head. A conspicuous blackish area around vent. Inside of mouth pale brownish. Fins more or less infuscated on the rays; median area of caudal dusky. Middle portions of posterior third dorsal rays dusky. One or more dark brown chromatophores at base of each anal ray.

Described and figured from the holotype of the species, a specimen 207 mm. or 8¼ inches in total length. It is the largest of seven specimens from the Great Australian Bight, trawled by the F.I.V. "Endeavour", south of Eucla in 350 to 450 faths., 14/5/1913. Regd. no. E.3555, on deposit in the Australian Museum.

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[1] Hickling, *Journ. Mar. Biol. Assoc.* (n.s.), xiii, 4, 1925, p. 914, pls.; *et ibid.*, xiv, 2, 1926, p. 495 and figs.

Thirteen paratypes 150 to 207 mm. long. were obtained by the "Endeavour" at the following localities:

Great Australian Bight, south from Eucla; 350 to 450 faths., 14/5/1913. (Six specimens, regd. nos. E.3555 (part), IB.1726, 1727 (dissected) and 1728).

Off Victoria (Lat. 38° 10′ S. by Long. 149° 55′ E.); 190–240 faths., 11/9/1914 (one specimen, E.5505).

Thirty miles S.W. of Gabo Island, Victoria; 240 faths., 12/9/1914 (two specimens, E. 5496–7, the latter being the smallest specimen, 150 mm.).

S.S.E. of Genoa Peak, Victoria, 200 faths., 5/10/1914 (four specimens, E.5503–4).

Range: Victoria and South Australia, 190 to 450 faths.

Suggested vernacular name: Grenadier Cod.

Measurements of largest and smallest specimens.

Dimensions in mm.	Holotype E.3555.	Smallest specimen, E.5497.
Total length	207	150
Length to anus	50	30
Predorsal length (from first dorsal)	40	26
Predorsal length (from second dorsal)	54	37·
Length of head	31·5	22
Length of orbit	13	8
Interorbital width	9	6
Depth of suborbital	2	1·5
Orbit to preopercle	8	4
Length of snout	8	5
Length of upper jaw	13	9·5
Length of barbel	3	1·5
Depth of body at second dorsal origin	33	22
Depth of caudal peduncle	3	3
Height of first dorsal fin	9	10
Height of second dorsal fin	28	25
Space between second and third dorsal fin (approx.)	74	55
Length of pectoral	23·5	15
Length of ventral	30	21
Length of caudal	15	9·5

Closely allied to *T. gilchristi* Boulenger, 1902, from deep water off Table Mountain, South Africa, but differing in having a steeper, shorter and more rounded snout, comparatively larger eye with consequent different proportions of the eye, interorbital and muzzle in relation to the head. The barbel of the Australian species is less than one quarter the eye-diameter, the third dorsal fin has a shorter base; the anal originates further forward and its anterior rays are longer in typical *gilchristi*. The Australian fish has 18 pectoral rays instead of 15, and the caudal fin is less pointed. However, some variation in fin-counts has been noted by Barnard (1925).

Family GADIDAE.

Subfamily MORINAE.

Genus **Mora** Risso, 1826.

Mora Risso, Hist. Nat. Europe Merid., iii, 1826, p. 224.

Haplotype, ***M. mediterranea*** = ***Gadus moro*** Risso, Ichth. Nice, 1810, p. 116, from Mediterranean.

Id. Gunther, Cat. Fish. Brit. Mus., iv, 1862, p. 341.

Id. Holt, Sci. Proc. Roy. Dublin Soc., (2) vii, 1891, p. 122.

Id. Holt and Calderwood, Trans. Roy. Dublin Soc., (2) v, 1895, p. 436, pl. xxxix, fig. 3, pl. xliv, figs. A and A′ (q.v. for refs. and synon.).

Id. Murray and Hjort, Depths of the Ocean, 1912, p. 400, fig. 278.

Id. Waite, Trans. N. Zeal. Inst., xlvi, 1914, p. 128.
Id. Saemundsson, Vidensk, Medd. nat. For. Kjobenh., lxxiv, 1922, p. 166.
Id. Benham, Otago Univ. Mus. Ann. Rept., 1925 (1926), p. 6.
Id. Oliver, Rept. Domin. Mus. Wellington, 1941, p. 8.

Mora dannevigi, sp. nov.

D. 8/49, A. 19 + 3 + 17, P. 19, V. 6, C. 22 branched rays. L.lat. circa 60. Tr. 6/14 to 16.

Head (55 mm.) 4·4, depth (47) 5·1, length of caudal (25) 9·6 in length (242). Eye (23) 2·4, snout (13) 4·2, and interorbital (11) 5 in head. Snout to vent 108 mm.

Head broadly rounded. Mouth extending below middle of the large elliptical eye. Interorbital space flat. Barbel present. Upper jaw the longer. Small, subequal, curved teeth in bands on jaws, not separated by grooves. Similar teeth in two vomerine patches. Gill-rakers slender and spinate, 4/11 on first branchial arch.

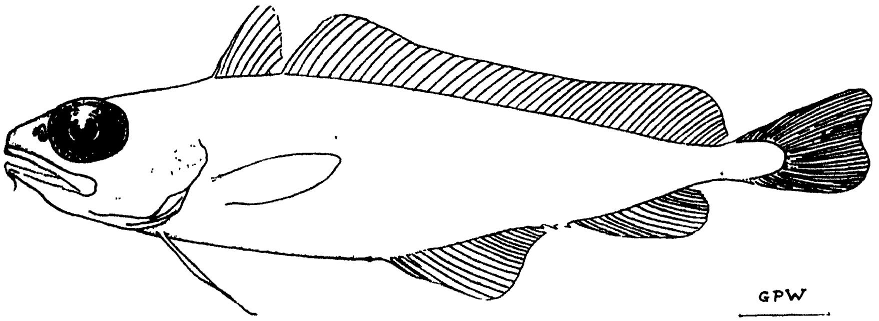

Figure 5.—Ribaldo, *Mora dannevigi* Whitley. Holotype from Great Australian Bight.

Body robust anteriorly, tapering to caudal peduncle whose depth is subequal to interorbital. Head and body with deciduous scales; lateral line complete with about sixty scale-pockets. Peritoneum black. Airbladder extending back to 24th vertebra. Vertebrae 53.

Two dorsal fins, the first of eight rays, the second of 49. Only some of the rays equal the eye in length. First anal originating nearer snout than caudal, with about nineteen rays, followed by a few dwarf rays between it and the second anal, which is smaller. Pectoral rather low, not reaching level of vent. Ventrals with six rays, filiform, longer than postorbital, but not greatly elongated. Caudal forked, upper lobe longer.

Colour after long preservation, generally pinkish to fleshy with blue tinges on opercles, body and eye. Fins pale yellowish with some dusky brown on first dorsal fin and anterior edge of second dorsal. Vent and inside of mouth, body and gills black.

Holotype and seven paratypes, 7¼ to 9¾ inches in total length (regd. nos. E.3544 and IB.1729–31) from the Great Australian Bight: Long. 129° 28′ E., South Australia; 350 to 450 faths. F.I.V. "Endeavour", 14 May, 1913. Preserved by H. C. Dannevig and deposited in the Australian Museum.

From the Old World type of the genus, *Mora moro* (Risso), generally called *M. mediterranea* Risso, and of which Holt and Calderwood (Sci. Trans. Roy. Dublin Soc., (2) v, 1895, p. 436, pl. xxxix, fig. 3, pl. xliv, figs. A–A′) have given a thorough account, the Australian species differs in having slightly different proportions, fewer lateral line scales (about 60 instead of 87 to 95), barbel not black, fewer vertebrae, and in its paler coloration.

The larger eyes, slenderer body and fewer scales also distinguish the new Australian species from *Mora pacifica* Waite (Trans. N. Zeal. Inst., xlvi, 1914, p. 128, pl. v) from New Zealand.

Subfamily GADINAE.

Genus **Merlangius** Geoffroy, 1767.

Merlangius Geoffroy, Descr. 719 Plantes et 134 animaux, 1767, p. 401, pl. 661. *Genus caelebs.* Logotype, *Gadus merlangus* Linné, by present designation = *Merlangius merlangus*, comb. nov.

Geoffroy's name is earlier than *Merluccius* or *Merlangus* Rafinesque, 1810; *Stomodon* Mitchill, 1814; *Polydatus* Gistel, 1847; and *Merlus* Guichenot, 1849 (preocc.) and should be used in their stead.

Family DIRETMIDAE.

Paradiretmus, gen. nov.

Orthotype, *Paradiretmus circularis*, sp. nov.

Allied to *Diretmus* but differs in having the anterior dorsal and anal rays spinous and preceded by a procumbent spine, the preoperculum is not produced so far downwards, scales are not so spinate, opercles are without raised laminae, etc. It cannot be the young of *Diretmus* because it is subcircular in shape, not skewed as in young *Diretmus*, and there are several fine preopercular spinules instead of one long spine.

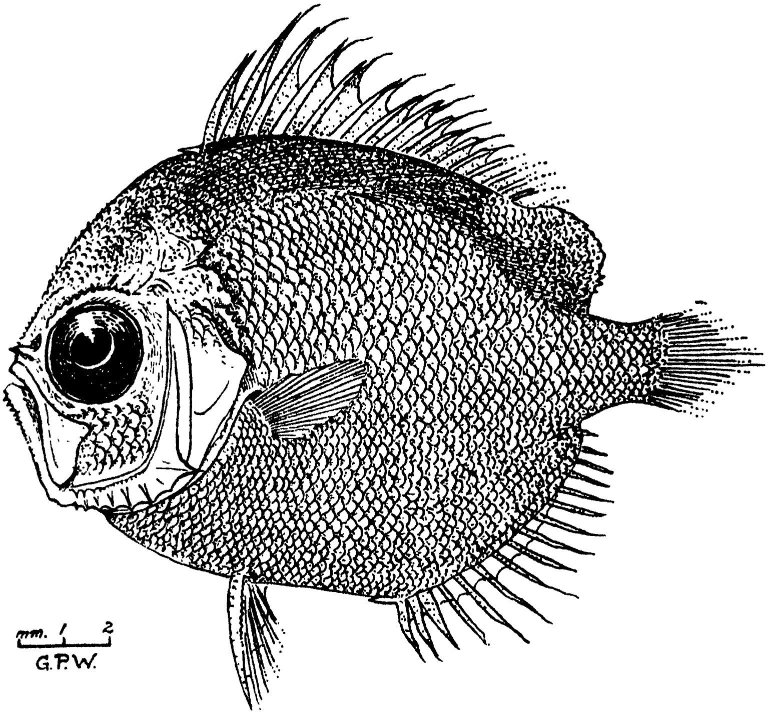

Figure 6.—Disc Dory, *Paradiretmus circularis* Whitley. Holotype from Lord Howe Island.

General characters as described for the species.

Although such a small fish, it has metamorphosed and is not in a larval phase such as a *Rhynchichthys*.

Paradiretmus circularis, sp. nov.

D. 16 + 9?, A.iii 13, P. 16, V.i 5, C. *c.* 13, Sc. *c.* 30.

Head (5 mm.) 2·8, depth (10) 1·4 in standard length (14). Eye, 2 mm.; interorbital 1·2; snout, less than 1; length of maxillary, about 2·3; equal to pectoral; depth of caudal peduncle, about 2.

Head compressed, high. Premaxillary extensible, with broad notch at symphysis. Maxillary broad posteriorly, its margin weakly sigmoid. I am unable to trace any supramaxillaries or teeth. Mandibulary rami curved and sweeping, not elevated. Chin with a row of spines down each side. Nostrils large, with papery edges, each preceded by a forwardly-directed spine and a spiny ridge. Eye large, supraorbital denticulated. Suborbital shallow. Top of head with spiny or lanceolate scales, descending over interorbital. About 5 or 6 rows of cheek-scales; cheeks not very deep. Preopercular edge papery with few fine spines below. Interoperculum with about six larger spines, the one at the angle reaching gill-cleft. Operculum smooth, lacking laminae as in *Diretmus*, and at least partly scaly; it ends in a spineless point, its superior margin being excavated around the base of a spiny scale. Another spiny scale above origin of lateral line. Gill-rakers slender, not numerous. No barbel. Form subcircular, very compressed. No bony bucklers. Caudal peduncle deep. Body covered with thin, imbricate, cycloid scales, some of which bear a central tubercle, but most have a median depression. Abdominal scales not keeled. Scales not extending over fins, but sheaths cover bases of posterior dorsal and anal rays. Lateral line obsolescent, merely a steeply ascending groove behind head and below anterior dorsal spines. Vent apparently about half-way between ventral base and anal origin.

Dorsal fin preceded by a procumbent spine, its anterior ten rays or so spinous and with pennate and incised membranes; posteriorly the rays are lost in a raised pad of back-flesh. Anal with procumbent spine, three thick pencilled spines and about thirteen filament-tipped rays, the posterior ones being sheathed by body-scales. Spinous fins not separated from soft. No perforations along base of membranes. Pectorals rather small and pointed. Ventral origin thoracic, slightly before level of pectoral. Caudal damaged, without procurrent rays. Fins without fulcra. The fin-rays do not appear to be divided or articulated.

Colour in alcohol: Unpaired fins yellowish. Base of dorsals and most of top of head grey. Back brown, indistinctly margined below with grey; the sides and breast silvery. Front of head and jaws yellow. Paired fins whitish. Eye blue and black.

Described and figured from the unique holotype, a specimen about 14 mm. in standard length or ⅝ in. overall. Austr. Mus. regd. no. IB.1944.

Loc.—From stomach of Kingfish (*Regificola grandis*) caught off Lord Howe Island, South Pacific; Mr. Robert Baxter, 1947.

This interesting little novelty swerves from *Diretmus* in the direction of the more normal Berycoid families and has something of the facies of such Zeomorphs as *Capromimus* and *Cyttus*, from which it is distinguished by the deeper caudal peduncle and spinous portions of dorsal and anal fins not separated from soft. The reduced number of ventral rays (i, 5) is an important character in the new genus, again suggesting affinity with *Diretmus* and the Caristiidae rather than the Berycoids and Zeoids. The normal scales of *Paradiretmus* are quite different from the ridge-like squamation of the Grammicolepidae.

Suggested vernacular name: Disc Dory.

Family REGALECIDÀE.

Regalecus pacificus Haast.

Regalecus pacificus Haast, Trans. N.Z. Inst., x, May, 1878, p. 246, pl. vii. New Brighton, New Zealand.

Occurrences of the rare Oar Fish are always worthy of record. Reviews of the Australasian cases of this species having been captured or stranded have been given by the present writer (Rec. Austr. Mus., xix, 1933, p. 70, and Austr. Mus. Mag., viii, 12, 1945, p. 425, figs.).

On 16th July, 1946, a further example came to light at Dee Why, New South Wales, where it was washed up in a fresh condition on some rocks. It was 11 ft. 6 in. (349 cm.) long and 11 inches deep, but had been damaged before I saw it the same afternoon. The tip of the tail appeared to have been bitten off, as usual in stranded specimens, but had healed, although there was still a little bleeding at the end of the vertebral column. The head, about 9 inches long, was preserved. Eye nearly 1½ in. Snout to vent, 54 in. The fins were very broken and the colours had faded. D. 243, the posterior rays further apart than the anterior ones.

The specimen was a female with fusiform ovaries, 3 ft. long by about 1¼ in. in diameter, containing thousands of minute, forming eggs. Peritoneum white. Liver bright salmon-reddish. Gall-bladder large and with much green bile. The stomach had about ten longitudinal plicae but contained nothing but some coarse sand which had probably been washed into it when the fish was cast ashore. Pyloric caeca numerous. No parasites. Austr. Mus. regd. no. I.B.1679.

The sea was almost flat calm, due to a N.W. wind, when the fish came ashore, and there had not been any stormy seas for some time beforehand. A second specimen was reported from Palm Beach on 24th July, 1946. On 27th June, 1947, another was washed ashore at Long Reef, not long after some very rough weather in Bass Strait and between Australia and New Zealand, the probable source of such stranded specimens. On 17th August, 1946, a Newcastle example is said to have been recorded in the "Newcastle Herald", and another Oar Fish was stranded on Manly Beach on 30th May, 1948.

Western Australian Examples.—In the Museum at Perth there is a very fine cast of this species and the following Western Australian specimens or records:

Regd. no.	
P.23.	Rottnest Island.
P.1145.	North Cottesloe, 8 ft.
P.1849.	Mandurah; 26th January, 1938, hooked. 113 × 6 × 2 inches. Tail missing. Also a photo (P.2084).
P.1915.	Busselton; December, 1938. 13½ ft.
—	North end of Garden Island; November, 1947. About 9 ft. ("Daily News", Perth, 18th November, 1947).

A Tasmanian Record.—The Hobart "Mercury" of 25th June, 1946, published a photograph of an Oar Fish, said to have been 11 ft. long, found at Sisters Creek, Tasmania, during the past week. It was preserved at the Queen Victoria Museum, Launceston.

In Victoria.—A specimen 13 ft. 3 in. long was lassooed by fishermen at Mordialloc, Victoria, on 31st May, 1946, and portrayed in the "Daily Telegraph", Sydney, 1st June, 1946.

Family ATHERINIDAE.

Craterocephalus marjoriae, sp. nov.

D.v/i 6, A.i 8, P.i 11, V.i 5, C. 17. Sc. 30 (28 on silver band). Tr. 7 or 8. Predorsal sc. 10. Interdorsal sc. 4.

Head (12 mm.) 3·0, depth (10) 3·7 in standard length (37).

Eye, 4 mm.; interorbital, 4·5; snout, nearly 4; depth of caudal peduncle, 4; length of pectoral, 6; predorsal length, 19; width of body at pectoral base, 6.

Form deep, compressed. Head flattened above, tapering down towards ventral profile; snout acutely pointed. Lower jaw included, mouth obliquely flexed rather as in *Pseudomugil*, extensile, the premaxillary pedicels shorter than eye. Teeth apparently microscopic or absent. Maxillary hardly reaching below anterior margin of eye.

Mandibular rami not elevated. Head scaly, except before eyes. About 7 + 10 short gill-rakers on first branchial arch.

Body covered with large, entire, cycloid scales, in about thirty transverse rows between head and hypural. Vent about 3 scales ahead of anal fin and hardly reached by adpressed tips of ventral fins. Two scale-rows between dorsal fins and lateral band. Four scales between base of pectoral fin and middle of chest.

No produced fin-spines. Origin of first dorsal nearer snout than root of tail. Anal base longer than that of second dorsal, about half its distance from caudal. Anal origin in advance of level of second dorsal origin. Third pectoral ray longest, reaching to above ventral base which is in advance of level of first dorsal. Caudal forked.

Colour after long preservation, light brown to yellowish, with a silvery lateral band nearly one scale wide. Eye silvery-yellowish. Fins plain or with few dark specks. Slight speckled edges to dorsal scales, but no spots as in *C. stercus-muscarum.* A median streak along caudal peduncle ventrally. Top of head dark-speckled.

Described and figured from the holotype, a specimen 37 mm. in standard length or 45 mm. overall, one of a series with eight paratypes, 1½ to 2 inches long. Austr. Mus. regd. no. I.12770.

Loc.—Eidsvold, Burnett River, Queensland; from Dr. T. L. Bancroft, 1913. Freshwater.

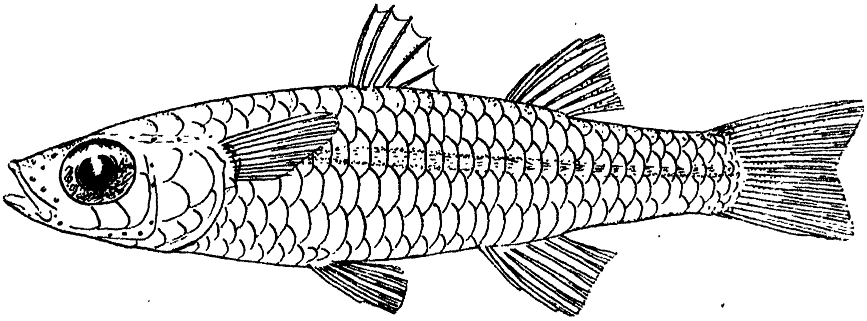

Figure 7.—Silverside, *Craterocephalus marjoriae* Whitley. Holotype from Eidsvold, Queensland.

This species is close to *C. cuneiceps* Whitley (Austr. Zool., x, 3, 10th May, 1944, p. 266, from Belele Station, Western Australia), but has about 30 scales and ventrals before level of first dorsal, whereas *cuneiceps* has about 38 scales and ventrals about opposite first dorsal. From other species it differs in proportions, scale-counts, etc.

Craterocephalus worrelli, sp. nov.

D.v/i 9, A.i 8, P.i 11, V.i 5, C 17. Sc. 33. Tr. 8. Predorsal sc. 13. Interdorsal sc. 5.

Head (14 mm.) 3·7, depth (10) 5·2 in standard length (52). Eye, 4 mm.; interorbital, 6; snout, 3·5; depth of caudal peduncle, 5; length of pectoral, 6; predorsal length, 25; width of body at pectoral base, 7.

Interorbital broad, scaly; head rather like a truncated pyramid. Lower jaw included, upper not flexed or concave laterally. Premaxillary pedicles shorter than eye. Teeth small, in bands. Maxillary not nearly reaching eye. Mandibular rami not elevated.

Form robust, scales cycloid. Vent 5 or 6 scales ahead of anal fin and situated between tips of ventrals. Three scale-rows between dorsal fin and main lateral band. Three and a half scale-rows between pectoral base and middle of chest.

Dorsal fin-spines slender, not produced. Origin of first dorsal nearer snout than root of tail. Anal base slightly longer than that of second dorsal and 1½ in its distance to caudal root. Anal origin in advance of level of second dorsal origin. Pectoral reaching level of ventral origin which is well ahead of level of first dorsal.

Colour in alcohol yellowish, with broad dark bar from snout, through eye, to tail, and having several less distinct dark bands above and below it. A median infuscated line along ventral surface of posterior half of fish. Fins and top of head mostly plain. Eye blue and silvery.

Described from the holotype, 52 mm. in standard length or 2½ inches overall. Austr. Mus. regd. no. IB.1915.

Loc.—Mataranka, Roper River system, Northern Territory of Australia; collected by Mr. Eric Worrell, 1947. Freshwater.

Distinguished from other species by the formulae, banded coloration, long snout and broad interorbital.

Atherinosoma (Taeniomembras) tropicalis, sp. nov.

D.vi/i 9, A.i 11, P.i 17, V.i 5, C. 15. Sc. 45 (43 on silver band). Tr. 6. Predorsal sc. 20. Interdorsal sc. 7.

Head (11 mm.) 3·6, depth (8) 5 in standard length (40). Eye, 4 mm.; interorbital, 4·1; snout, 2·5; depth of caudal peduncle, 3·3; length of pectoral, 7; predorsal length, 22; width of body at pectoral base, 6.

Form slender. Snout rounded. Lower jaw included, mouth oblique, not flexed, extensile. Premaxillary processes short. Teeth extend along upper jaw externally, elsewhere they are microscopic or absent. Mandibular rami elevated. Head scaly, except before eyes. Gill-rakers slender and numerous (more than 15 on lower part of first arch). No conspicuous pores on vertex but a series on snout and around chin

Body covered with large, entire, cycloid scales, some of them pored, especially along silver band, where there are more than 40 scales. Vent about 7 scales ahead of anal fin and lying near ventral tips. Two scale-rows between dorsal fin and lateral band. Five scale-rows between pectoral base and middle of chest.

No produced fin-rays. Origin of first dorsal nearer snout than root of tail, behind level of vent. Anal base somewhat less than its distance to caudal.

Colour, in alcohol, yellowish-brown with a broad lateral silvery band, bordered above and below with darker, occupying nearly 2 scales in depth. Scales of back with two or three milky or blue spots, sometimes joined, and the usual punctulations. Snout and end of caudal dusky. Top of head dark with milky markings. Some brown along bases of pectorals and anal. No dark bars or spots on body. Fins plain. Eye silvery. No median ventral streak along caudal peduncle.

Described from the unique holotype, a specimen 40 mm. in standard length or nearly 2 inches long overall. Austr. Mus. regd. no. IA.1553.

Loc.—Whitsunday Passage, near Bowen, Queensland; Mr. E. H. Rainford, 1923.

A marine species distinguished from other Australian Atherines by its fin and scale-counts, short premaxillary pedicels, external teeth, numerous gill-rakers, etc., as described.

Family NOMEIDAE.

Caristioides, gen. nov.

Orthotype, *C. amplipinnis*, sp. nov.

A genus of rather small Stromateiform fishes with the body ovate, strongly compressed, with firm flesh. Eyes large, with very narrow rims. Interorbital broad, flat, converging anteriorly. Snout tumid. Upper jaw not protactile. Maxillary rounded, reaching below front of pupil, with supplementary bone. A row of spaced, conic, well-developed teeth in each jaw, largest near upper symphysis and sides of mandible. Tongue and palate toothless. Oesophageal teeth cannot be examined without damaging the unique specimen. Head with some mucus pores and a series of tubes around preopercular limb, the edge of which is not serrated. Cheeks and opercles scaleless, perhaps through scales being deciduous. Interoperculum and operculum not spinous. Gill-openings very wide, joining across the narrow isthmus. Pseudobranchiae present. Nostrils small, near end of snout. Gill-rakers rather thick, about one-third eye-diameter, about 13 on lower part of first branchial arch. First dorsal fin with ten weak spines. The last is joined by membrane to the soft dorsal fin, which is higher, has about thirty rays and forms a pointed lobe overhanging tail. The anal fin is damaged but was evidently similar to soft dorsal. Pectorals fairly large, median rays longest. Ventrals long and slender, reaching anterior anal rays, their origin behind level of pectoral base. Caudal long and forked. Body deep, compressed strongly, axis of caudal peduncle bent downwards. Body-scales very small, imbricate, cycloid. L. lat. with small, simple, close-set tubes, near and roughly parallel to outline of back and ceasing below posterior dorsal rays. Vent slit-like. Scales extend little, if at all over fins. Coloration plain.

Differs from all the Stromateiformes in having the above combination of characters, and easily distinguished by its numerous finrays and scales, forked caudal and extensive fins. It is apparently nearest *Psenes* (Cuv. and Val., Hist. Nat. Poiss., ix, 1833, p. 259, pl. 265), but has more numerous finrays, much higher soft dorsal and anal fins, and much smaller scales.

Caristioides amplipinnis, sp. nov.

D. *circa* x 31, A (iii?) 30, P. 20, V.i 5?, C. 17. L.lat. *circa* 93 (left) or 75 (right). Because of the vestigial nature of some of the spines, rays and of l.lat. scales, only an approximate formula can be given.

Head (27 mm.) 2·6, depth (40) 1·7 in standard length (71). Eye (8·5) greater than snout (7) which is subequal to interorbital (7·5). Length of pectoral, 22 mm.; of ventral, 23; upper caudal lobe, 27. Height of dorsal lobe, 18 mm.

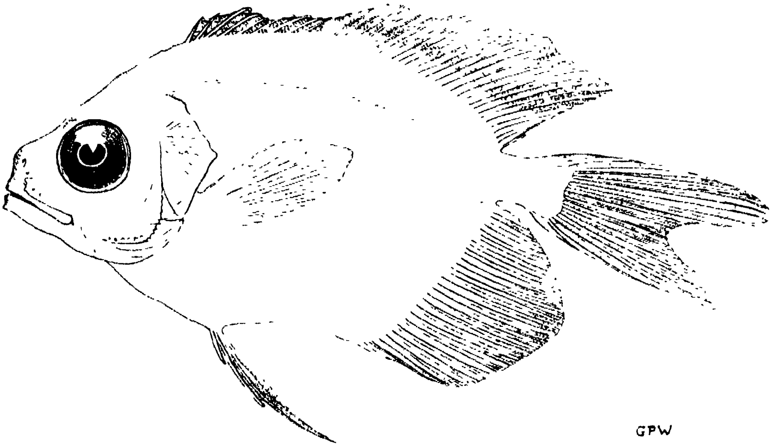

Figure 8.—Harvest Fish, *Caristioides amplipinnis* Whitley. Holotype from Lord Howe Island.

General characters are defined for genus. Third dorsal spine lengthened. Last dorsal ray divided to base.

Coloration (in alcohol), plain yellowish to pale brown, finely dotted.

First dorsal and ventrals dark brown. Other fins with brown and white transverse areas. Pale bars at junctions of fins with body. Eye blue. Total length 100 mm. or 4 inches.

Described from the unique holotype. Austr. Mus. regd. no. IA.1395.

Loc.—Lord Howe Island; Mr. R. Baxter. Found washed ashore in 1923. Suggested vernacular name: Lord Howe Island Harvest-Fish.

Family EPINEPHELIDAE.

Genus Trachypoma Gunther, 1859.

Trachypoma Gunther, Cat. Fish. Brit. Mus., i, 1859, pp. 54 and 167. Not *Trachypoma* Giebel, Z. ges. Naturw., xxxvii, 1870, p. 97 = *Eremophilus* Humboldt, 1805, a genus of Catfishes, *fide* Gunther.

Trachypoma macracanthus Gunther.

Trachypoma macracanthus Gunther, Cat. Fish. Brit. Mus., i, 1859, p. 167. Norfolk Islands. *Id.* Boulenger, Cat. Perc. Fish. Brit. Mus., (2) i, 1895, p. 146, pl. ii (type). *Id.* Waite, Trans. N.Z. Inst., xlii, 1910, pp. 377 and 381 (Kermadecs, Norfolk and Lord Howe Iss.). *Id.* Kendall and Radcliffe, Mem. Mus. Comp. Zool., xxxv, 1912, pp. 107 and 168 (as *macracanthum*). *Id.* Regan, Proc. Zool. Soc. London, 1913, pt. 3, p. 373. *Id.* Rendahl, Nat. Hist. Juan Fernandez and Easter Id. (ed. Skottsberg), iii, 1920, pp. 60 and 63 (Easter Id.). *Id.* Fowler, Mem. Bern. P. Bish. Mus., x, 1928, p. 171.

This species may now be added to the Australian list as the late G. McAndrew obtained a specimen from Shellharbour, New South Wales, in May, 1925. It was nearly 9 inches long, a record length. Austr. Mus. regd. no. IA.2458. The Pacific Perch, as this may be called, is common at Lord Howe Island; the types came from Norfolk Island, and the species has been recorded from the Kermadecs and Easter Island.

Epinephelus thompsoni, sp. nov.

Br. 7, D.xi 13, A.iii 8, P. 18. L.lat. about 83 to hypural joint + 7 to caudal base. L.tr. about 17/1/43 from dorsal origin to vent, and 10/1/10 on caudal peduncle.

Head (200 mm.) 2·4, depth (153) 3·2 in standard length (about 490). Eye (36) 5·5, snout (about 50) about 4 in head. Interorbital, 29 mm.; snout to end of maxilla, 94; depth of maxilla, 25; depth of cheek, 68; length of pectoral, 100.

Head large, deep, only naked before eyes and on lower surfaces. Interorbital scaly, broadly convex. Only the posterior margin of preoperculum serrated plus some enlarged and jutting serrae at angle. Opercular flap rounded, its upper margin slightly convex. Three opercular spines, the upper one small and most anterior, the middle and lower large and strong and closer together. Maxillary truncate, naked, with narrow supplemental bone. Tongue small and rounded. Strong cardiform teeth on jaws, vomer, and palatines, some of them enlarged near upper symphysis and along the mandibles at the sides of which the teeth are in two rows. One or two small canines on each side of symphysis in each jaw, these not depressible like the cardiform teeth. Nostrils subcircular, anterior with skinny flap. Gill-rakers, excluding rudiments, 7/15 on first branchial arch; they are short and spiny, the longest (10 mm.) at the angle.

Body compressed but robust, deepest at level of gill-flaps. Comparatively large adherent ctenoid scales, longitudinally striated and with numerous basal radii, cover the body but hardly trespass on the fins. The scale-rows do not ascend steeply but more or less regularly follow the body-contours. Course of l.lat. normal, its tubes simple.

Bases of spinous dorsal fin notably longer than that of soft, its third spine longest (58 mm.) and subequal to longest rays. Anal spines strong, third longest. Pectorals rounded, 7th ray longest. Ventrals with strong spine, rooted below pectoral axil. Caudal broadly convex.

General colour, after long preservation in formalin, light brown. Margins of unpaired fins dark brown. A dark spot on each body-scale. No dark moustache or other conspicuous markings.

Described from the holotype of the species, a gutted specimen about 490 mm. in standard length or about 23 inches overall. Regd. no. E.2116.

Locality.—36½ miles N.E. of Cape Moreton, Queensland; 70 to 75 fathoms. F.I.V. "Endeavour".

Named in honour of Dr. Harold Thompson, Chief of the Division of Fisheries, C.S.I.R.

Distinguished especially by its rather large size, plain coloration, two rows of mandibular teeth, small round tongue, and rather large scales.

Apparently nearest *malabaricus* but has deeper body, and upper opercular spine not so advanced in relation to lowest, and maxillary naked, no large brown spots or blotches, etc.

Family CARANGIDAE (?) or JUVENELLIDAE, nov.

Juvenella, gen. nov.

Orthotype, *J. carangoides*, sp. nov.

Superficially similar to a young trevally (*Usacaranx*) but at once separable by its deeper, compressed caudal peduncle, without scutes, more convex ventral, profile, and ten dorsal spines, the posterior ones not much shorter than the longest anterior ones. Body with ctenoid scales which extend over all the breast. Dorsal and anal spines contiguous to their rays.

General facies as figured and details as described for species.

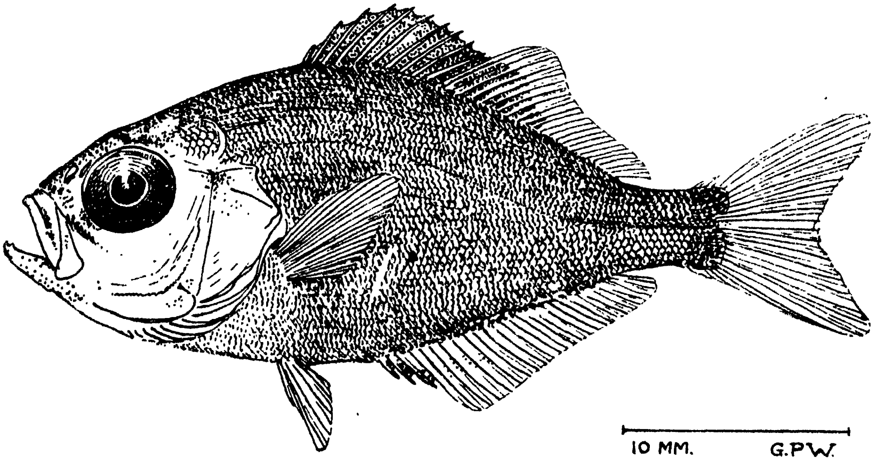

Figure 9.—False Pompano, *Juvenella carangoides* Whitley. Holotype from Newport, New South Wales.

Perhaps this new genus is nearer *Lactarius* and *Bathystethus* than the more typical Carangidae, which have the anal spines remote from the anal rays, or it may be thought sufficiently distinct to represent a new family, the Juvenellidae.

Juvenella carangoides, sp. nov.

Br. 7, D.x 25, A.iii 26, P.i 18, V.i 5, C. 15 branched rays. L.lat. 83 to hypural. L.tr. 17/1/36 to 5/1/5 on caudal peduncle. About 20 predorsal scales.

Head (10 mm.) 3, depth (13) 2·3 in standard length (30). Snout (2) 2 in eye. Eye (4) 2·5, interorbital (3) 3·3, depth of caudal peduncle (3·2) 3·1 in head. Length of pectoral, 6·5 mm.

Head naked, except on temples. Few pores. Nostrils large, pear-shaped, front ones with raised posterior rim. Eyes large; interorbital convex. Mouth small, maxillary bluntly rounded, reaching below front portion of eye. Premaxillary pedicels short. Bands of fine teeth on jaws; some fine, enlarged teeth in an outer row on dentary. Apparently no palatal teeth. Tongue-tip rounded, free. Velum maxillare present. Preorbital serrated. Margin of preopercle denticulated, other opercles entire. Blunt opercular spines. Gill-openings wide, the membranes joined to a very narrow isthmus. Gill-rakers long and slender, 25 on lower portion of first branchial arch, about as long as second row of gill-fringes, the first row of gill-fringes being short. Pseudobranchiae present.

Body compressed, deep, covered with very small scales which are strongly ctenoid and have several conspicuous concentric rings. The body is broadest immediately behind the head. Lateral line complete, only slightly and evenly bowed, each of its scales with a simple, raised tube. No scutes. Breast not naked. No axillary processes or scales. Vent on the flattened abdomen a little in advance of anal fin; no genital papilla. No scaly sheaths to fins. Caudal peduncle compressed, without keel. Dorsal and anal fins with their spines contiguous to the soft rays, their form as figured. Pectorals and ventrals rounded. Lower pectoral rays normal, not finger-like. Caudal forked. No finlets or produced rays or procumbent spine.

Colour, brownish to dark blue above, steel-blue to grey on the sides, and silvery below. Snout, top of head, caudal base, spinous dorsal and antero-proximal part of soft dorsal densely infuscated; some dark dots along anal base. Fins otherwise whitish. Eye bluish. Snout and front of head pale whitish. In the two small paratypes the foremost dorsal rays are white, followed by a dusky patch.

Described and figured from the holotype (the largest of three specimens with the same data), 30 mm. in standard length or 1½ inches overall. Austr. Mus. regd. no. IB.1733.

Loc.—Newport, near Sydney, New South Wales; in rockpool, 11th October, 1946. Miss Elizabeth Pope.

Miss Pope later (29th December, 1947) collected another small paratype at Long Reef, New South Wales. It was in a pool at low water among the alga *Phyllospora* which it resembled remarkably in colour. It is 34 mm. overall and has about seven fuscous cross-bars, the second dorsal fin is nearly all dusky olivaceous and there is a similar dark patch on anal fin anteriorly; iris pinkish, surrounded by yellow which extends over top of head. Austr. Mus. regd. no. IB.1983.

The affinities of this puzzling little fish are uncertain. At first sight it appeared like a young Carangid, even having a coloration somewhat suggestive of the *Nauclerus* stage of *Naucrates*, but its fin-formulae, with the spines and rays in contact, clearly separate it from any member of the Carangidae. It probably grows to a considerably larger size than the described specimen which, however, has quite lost its larval characters though, possibly at a later stage of growth, it might develop scales on the cheeks.

I have been unable to trace any genus like this fish in the Museum collections or described in literature.

Suggested vernacular name: False Pompano.

Family SERIOLIDAE.

Regificola parilis, sp. nov.

D.vi/i 32, A.ii 21, P.i 22. L.lat. *c.* 140 to hypural joint or 165 altogether.

Head (191 mm.) 3·7, depth (160) 4·4 in length to caudal fork (715). Eye, 33 mm.; interorbital, 69; snout, 62; maxillary, 82; base of first dorsal, 60; of second, 262; of anal, 180; length of pectoral, 83; of ventral, 100; depth of caudal peduncle, 27.

General characters as in the common Yellowtail Kingfish, *Regificola grandis* (Castelnau, 1872), but that species has smaller eye (more than 7 in head), more slender form and less arched upper profile of head, lower dorsal spines and more gill-rakers.

In the new species the maxillary is deep, reaching below anterior third of eye and with distinct supramaxillary. Gill-rakers 3/12, all less than eye-diameter. Anal rays higher than those of dorsal. Lateral line very slightly curved. First dorsal originating well behind level of pectoral base.

Described from the holotype, a specimen 714 mm. in length to caudal fork or 33 inches overall. Qld. Mus. regd. no. I.6709.

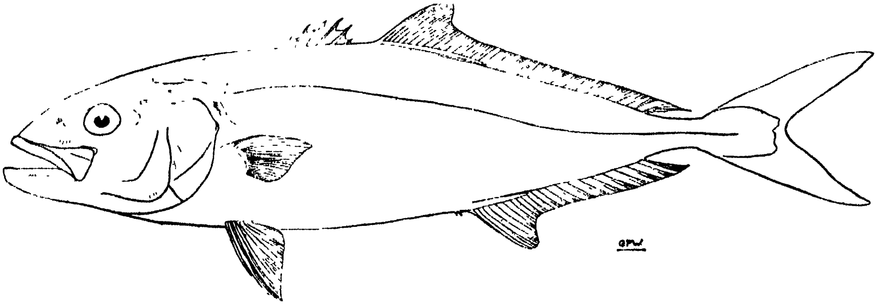

Figure 10.
Allied Kingfish, *Regificola parilis* Whitley. Holotype from southern Queensland.

Loc.—Mooloolabah, Queensland; caught by Mr. F. Z. Eager in May, 1939. Other specimens seen in the Brisbane Fish Markets.

This is the *Seriola dumerili* recorded by Marshall (Mem. Qld. Mus., xii, 1941, p. 57) but it differs from the Seriola or *Caranx dumerili* of Risso (Ichth. Nice, 1810, p. 175, pl. vi, fig. 20), the latter having 18 pectoral rays, larger teeth, more pointed head, etc.

Family CHANDIDAE.

Denariusa, gen. nov.

Orthotype, *D. bandata*, sp. nov.

Near *Ambassis* Cuvier and Valenciennes (*Hist. Nat. Poiss.*, ii, 1828, p. 176, pl. xxv) but differs in having a much smaller mouth, fewer scales between head and tail, obsolete lateral line, fewer pectoral rays, no procumbent dorsal spine, no supraorbital spine and in its darker, banded coloration.

General characters as described below and facies as figured.

The original figure shows five rows of cheek-scales in *Ambassis* but Bleeker's "Atlas" figures it with only two as in my new genus, which also has no lingual teeth and only 13 caudal vertebrae.

This new genus is evidently nearer to *Ambassis* (sensu lato) than *Xenambassis* Schultz (*Proc. U.S. Nat. Mus.*, xcvi, 1945, p. 115), having the strongly notched dorsal fins and peaked spinous dorsal of the former genus.

Denariusa bandata, sp. nov.

D.vii, i, 9; A.iii, 9; P. 9; C. 17; Sc. 25; l. lat. obsolete; l. tr. 12; Predorsal sc. 11.

Head (9) 2·5, depth (10) 2·3 in standard length (23). Eye (2·7) 3·3, snout (2) and length of maxillary (2) equal to interorbital (2) 4·5 in head; depth of caudal peduncle (4) less than postorbital (4·1). Longest dorsal spine, 5 mm.; longest anal spine, 4 mm. Anterior profile not much notched over eyes. Supraorbital spineless. Interorbital flat with two ridges. Eyes large. Mouth small, slightly protractile, barely reaching eye.

Lower jaw the longer. Teeth minute on jaws, vomer and palatines; none on tongue. Maxillary exposed, its posterior edge convex. Nostrils large. Some mucus pores around eye, nape and preopercular flange. Preorbital and lower edge of preoperculum and its angle denticulate. Interoperculum entire. Operculum pointed. Cheeks shallow; two rows of cheek-scales, the lower smaller. Opercles scaly. Gill-membranes united, free of the narrow isthmus. About six short gill-rakers on lower limb of first branchial arch.

Dorsal profile more convex than ventral. Body compressed, fairly deep, covered with small cycloid scales except on top of head. Lateral line obsolete (very faint traces of up to five rudimentary tubes with 3 or 4 rows of scales above them in a few paratypes). About eleven (10 to 13 in paratypes) predorsal scales form a faint ridge posteriorly. Eight scales before ventral fins. Vent half-way between ventral and anal origins.

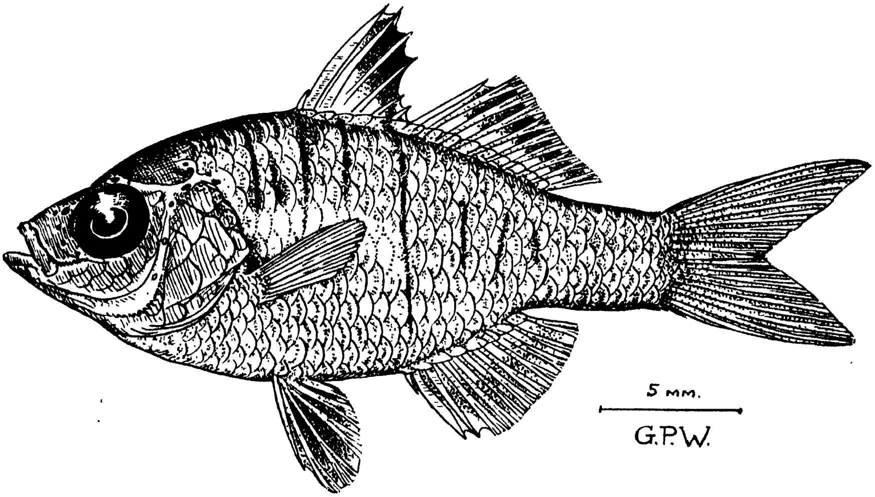

Figure 11

Chanda Perchlet, *Denariusa bandata* Whitley. Holotype from the Northern Territory.

Dorsal fins deeply notched, the short seventh spine connected by membrane to near base of spine of second dorsal fin. Spinous dorsal much higher than soft dorsal. Second dorsal spine long, reaching, when depressed, beyond base of spine of second dorsal fin. Two dorsal bases about equal in length. Second anal spine slightly shorter than third. Soft dorsal and anal with scaly sheaths. About nine simple rays in the small pectoral fins. Ventrals reaching vent, with small axillary scales, their insertion behind level of pectoral base. Caudal forked.

General colour in preservative, brownish with scales darker towards their margins. Up to six vertical dark brown bars on body. Dorsal with a broad black inframarginal area. Anal and ventral dusky. Pectorals and caudal lighter, plain. A cluster of dark chromatophores form a small blotch over pectoral axil. Eye blue. No silvery lateral band, no dark stripe along caudal peduncle.

Described and figured from the holotype of the species, a specimen 23 mm. in standard length, or $1\frac{3}{16}$ inches overall, largest of a series of fifteen. Austr. Mus. regd. no. IB.2035 (holotype) and 2036-2037 (14 paratypes). The paratypes show little variation; dorsal rays 9 to 11; anal rays 8 to 9; Sc. 21 to 25.

Loc.—Coastal plains of Arnhem Land, Northern Territory of Australia; "found in brackish waters in large numbers after the wet season". Submitted for identification by Dr. D. Thomson, Dept. of Anthropology, University of Melbourne.

Family TRICHIURIDAE.

Tentoriceps, gen. nov.

Orthotype, *Trichiurus cristatus* Klunzinger (Fische Rothen Meeres, 1884, p. 120, pl. xiii, fig. 5, Koseir) = *Tentoriceps cristatus.*

Profile of head convex, ridge-like, trenchant; a high, leaf-like, curved crest springs from dorsal origin over interorbital and snout; the front part of the latter, however, not more sharpened. The eyes are situated well below the profile. Ventrals in the form of a pair of scales. Lateral line descends very gradually backwards and runs a little above the lower third of the body. Anal with only rudimentary, hardly perceptible spinelets. Eye large, 5 in head and 2 in snout. Head fairly long, 2¾ times depth of body and 9 in total length. Depth 20 to 24 (latter in older specimens) in total length, body thus very elongate. Dorsal rays 1¼ in depth of body, 3½ in head, thus rather low. Pectorals short, 7 in head (if not broken short). Whiptail short, only ½ head. Front teeth entire, without barbs. Colour silvery, dorsal transparent.

Family CALLYODONTIDAE.

Callyodon laxtoni, sp. nov.

D.ix 10, A.iii 9, P.ii 11. L.lat. 16 + 18. Tr. 2/1/6. Predorsal 6.

Head (81 mm.) equal to depth and nearly 3 in standard length (242). Eye (12) 6·7, interorbital (26) 3·1, snout (32) 2·5, mouth-cleft (15) 5·4, pectoral (56) 1·4 and depth of caudal peduncle (34) 2·3 in head. Fish widest at operculum (38 mm.).

Head somewhat tapering, profile slightly convex, not gibbous. Nostrils inconspicuous. Eyes rather small. Interorbital broadly convex. Teeth whitish, coalesced into a smooth beak with rather irregular cutting edges. Posterior canines present. Lips extend over about basal half of teeth.

Cheek-scales in three rows, the lowest row of 3 or 4 scales covering lower preopercular flange. Gill-rakers hair-like or pectinate, 28 along lower limb of first branchial arch.

Body covered with cycloid scales with about 29 basal radii and reticulated centres. Last scale of lateral line enlarged. L.lat. interrupted by one tubeless scale on one side of fish, continuous on the other. General facies as in the genus. Caudal truncate or shallowly biconcave.

General colour, in alcohol, leaden bluish-grey above and down to breast; orange below and over tail. Pectoral base and upper portion dark grey, the lower portion and posterior margin orange. A narrow dark edge to anal. No conspicuous lines, bands or blotches, not even on head or lips. Teeth whitish.

Described from the holotype of the species, 242 mm. in standard length or 11 inches overall. Austr. Mus. regd. no. IB.1888.

Loc.—Ocean Island, 1947; named in honour of its collector, Lt.-Col. P. B. Laxton, Lands Commissioner at Tarawa, Gilbert Islands.

Distinguished from other species by its three rows of cheek-scales, covering the lower preopercular flange; non-gibbous profile, coloration, etc.

A REFERENCE LIST OF TYPES OF COLEOPTERA IN THE AUSTRALIAN MUSEUM.*

By Keith C. McKeown,
Assistant Entomologist, Australian Museum.

This list of the types of Coleoptera in the Australian Museum has been compiled with the purpose of assisting workers in the Order, as many enquiries are received both from Australian and overseas students regarding the location of certain types.

With the ever-increasing number of described species and the consequent necessity for access to the types, a knowledge of their present location is imperative. The position is rendered difficult by the transfer of material from private collections to institutions such as this, as in the original descriptions the types are stated to be in the author's collection. Certain collections have been acquired by the Australian Museum, and the types are now housed in its collection, e.g., the A. H. Elston Collection, and types from the H. J. Carter Collection.

Especial difficulty is experienced in tracing the Macleay types, since these are to be found both in the Australian Museum and in the Macleay Museum, University of Sydney. The types contained in the Australian Museum might, perhaps, be described as 'type-series', but where they are stated to be 'Holotype and Paratype' in the present list, the specimen bearing the original name label has been selected as the Holotype. Types in the Macleay Museum Collection are not specially indicated as such, and their determination is necessarily a matter of difficulty.

CICINDELIDAE.

Distipsidera mastersi Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 80. Holotype and Paratype.
Megacephala cylindrica Macleay. *Id.*, i, 1863, p. 11. Holotype and Paratype.
Tetracha crucigera Macleay (*Megacephala*). *Id.*, i, 1863, p. 10. Holotype and Paratype.
  humeralis Macleay (= *Megacephala australasiae* Hope, 1841). *Id.*, i, 1863, p. 9. Holotype and Paratype.
  scapularis Macleay (*Megacephala*). *Id.*, i, 1863, p. 10. Holotype.

CARABIDAE.

Abacetus angustior Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 105. Holotype.
  ater Macleay. *Id.*, ii, 1871, p. 105. Holotype.
Adelotopus analis Macleay. *Id.*, ii, 1871, p. 95. Holotype.
  mastersi Macleay. *Id.*, ii, 1871, p. 94. Holotype.
Agonocheila suturalis Macleay. *Id.*, ii, 1871, p. 91. Holotype.
Amblytelus amplipennis Macleay. *Id.*, ii, 1871, p. 106. Holotype and Paratype.
  minutus Macleay. *Id.*, ii, 1871, p. 106. Holotype.
Apotomus mastersi Macleay. *Id.*, ii, 1871, p. 95. Holotype.
Argutor foveipennis Macleay (*Prosopogmus*). *Id.*, ii, 1871, p. 110. Holotype.
  nitidipennis Macleay (*Prosopogmus*). *Id.*, ii, 1871, p. 111. Holotype.
  oodiformis Macleay (*Prosopogmus*). *Id.*, ii, 1871, p. 111. Holotype.
Badister archiomenoides Macleay (= *Microferonia macleayi* Csiki, 1931). *Id.*, **ii, 1871**, p. 120. Holotype.

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* In 1941 the prevailing conditions were such that publication of this paper, prepared in 1939, had to be deferred indefinitely; accordingly in Records of the Australian Museum, Vol. xxi, No. 1, on page 56, a note was published announcing the availability of the manuscript for reference. The author, in the intervening period, has kept the list current.—Editor.

Bembidium amplipenne Macleay (*Tachys*). *Id.*, ii, 1871, p. 119. Holotype.
  atriceps Macleay (= *Tachys fasciatus* Motsch., 1851). *Id.*, ii, 1871, p. 116. Holotype.
  bifoveatum Macleay (*Tachys*). *Id.*, ii, 1871, p. 117. Holotype.
  bipartitum Macleay (*Trechodes*). *Id.*, ii, 1871, p. 120. Holotype.
  bipustulatum Macleay (*Tachys*). *Id.*, ii, 1871, p. 116. Holotype.
  bistriatum Macleay (= *Tachys convexus* Macleay, 1871). *Id.*, ii, 1871, p. 115. Holotype.
  brunnipenne Macleay (*Tachys*). *Id.*, ii, 1871, p. 118. Holotype.
  convexum Macleay (*Tachys*). *Id.*, ii, 1871, p. 115. Holotype.
  flavipes Macleay (= *Trechodes bipartitus* Macleay, 1871). *Id.*, ii, 1871, p. 119. Holotype.
  gagatinum Macleay (*Thenarotidus*). *Id.*, ii, 1871, p. 119. Holotype.
  ovatum Macleay (= *Tachys bifoveatus* Macleay, 1871). *Id.*, ii, 1871, p. 117. Holotype.
  punctipenne Macleay (= *Tachys monochrous* Schaum, 1863). *Id.*, ii, 1871, p. 116. Holotype.
  rubicundum Macleay (= *Tachys flindersi* Blackburn, 1888). *Id.*, ii, 1871, p. 118. Holotype.
  sexstriatum Macleay (= *Tachys mastersi* Sloane, 1921). *Id.*, ii, 1871, p. 117. Holotype.
  striolatum Macleay (*Tachys*). *Id.*, ii, 1871, p. 115. Holotype.
  transversicolle Macleay (*Tachys*). *Id.*, ii, 1871, p. 116. Holotype.
Carenum angustipenne Macleay. *Id.*, ii, 1871, p. 98. Holotype.
  coracinum Macleay. *Id.*, i, 1865, p. 178. Holotype.
  deauratum Macleay (*Laccoscaphus*). *Id.*, i, 1863, p. 140. Holotype and Paratype.
  ovipenne Macleay (= *C. simile* Macleay, 1865). *Id.*, ii, 1871, p. 98. Holotype.
  politulum Macleay (= *C. subporcatulum* Macleay, 1865). *Id.*, ii, 1871, p. 98. Holotype.
  salebrosum Macleay (*Laccoscaphus*). *Id.*, ii, 1871, p. 97. Holotype and Paratype.
  viridimarginatum Macleay (= *C. subporcatulum* Macleay, 1865). *Id.*, ii, 1871, p. 97. Holotype and Paratype.
Catascopus chalydicus Olliff. *Proc. Linn. Soc. N. S. Wales*, x, 1885, p. 470. Holotype.
Chlaenioidius planipennis Macleay (= *C. prolixus* Erichson, 1842). *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 109. Holotype and Paratype.
Clivinia debilis Blackburn. *Proc. Linn. Soc. N. S. Wales*, iv (2), 1889, p. 722. Paratype.
Cyclothorax punctipennis Macleay (*Mecyclothorax*). *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 105. Holotype.
Dromius humeralis Macleay (= *Microlestes macleayi* Csiki, 1932). *Id.*, ii, 1871, p. 88. Holotype.
Drypta mastersi Macleay. *Id.*, ii, 1871, p. 82. Holotype and Paratype.
Eucalyptacola mastersi Macleay (*Catascopus*). *Id.*, ii, 1871, p. 91. Holotype.
Eulebia plagiata Macleay (= *Lebia melanota* Chaudoir, 1871). *Id.*, ii, 1871, p. 87. Holotype.
Euryscaphus minor Macleay (= *E. dilatatus* Macleay, 1865). *Id.*, i, 1865, p. 189. Holotype.
Gigadema politulum Macleay (= *G. longipenne* Germar, 1848). *Id.*, ii, 1871, p. 83. Holotype and Paratype.
Harpalus aeneonitens Macleay (*Nemaglossa*). *Id.*, ii, 1871, p. 102. Holotype.
  angustatus Macleay (*Diapheromerus*). *Id.*, ii, 1871, p. 102. Holotype.
  atroviridis Macleay (*Hypharpax*). *Id.*, ii, 1871, p. 103. Holotype and Paratypes.
  convexiusculus Macleay (*Hypharpax*). *Id.*, ii, 1871, p. 102. Holotype and Paratype.
  gayndahensis Macleay (*Nemaglossa*). *Id.*, ii, 1871, p. 102. Holotype.
Helluosoma mastersi Macleay (*Epimicodema*). *Id.*, ii, 1871, p. 83. Holotype.
Homothes marginipennis Macleay. *Id.*, ii, 1871, p. 89. Holotype and Paratype.
  velutinus Macleay. *Id.*, ii, 1871, p. 88. Holotype.

Lecanomerus aberrans Macleay (*Nemaglossa*). *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 101. Holotype.

ruficeps Macleay (*Nemaglossa*). *Id.*, ii, 1871, p. 100. Holotype and Paratype.

Lestignathus fugax Olliff. *Mem. Aus. Mus.*, ii, 1889, p. 80. Holotype.

Meonis ovicollis Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 100. Holotype and Paratype.

Morio longicollis Macleay. *Id.*, ii, 1871, p. 95. Holotype.

seticollis Macleay (= *M. novaehollandiae* Castelneau, 1867). *Id.*, ii, 1871, p. 96. Holotype and Paratype.

Parroa australis Sloane. *Proc. Linn. Soc. N. S. Wales*, v (2), 1890, p. 236. Holotype.

Notonomus angustipennis Macleay (= *N. nitidicollis* Chaudoir, 1865). *Id.*, ii, 1871, p. 109. Holotype.

arthuri Sloane. *Proc. Linn. Soc. N. S. Wales*, iv (2), 1889, p. 1294. Holotype.

cyaneocinctus Macleay (= *N. nitidicollis* Chaudoir, 1865). *Id.*, ii, 1871, p. 108. Holotype.

purpureipennis Macleay (= *N. nitidicollis* Chaudoir, 1865). *Id.*, ii, 1871, p. 107. Holotype.

violaceomarginatus Macleay (= *N. nitidicollis* Chaudoir, 1865). *Id.*, ii, 1871, p. 108. Holotype.

viridicinctus Macleay (= *N. nitidicollis* Chaudoir, 1865). *Id.*, ii, 1871, p. 108. Holotype.

Nuridus fortis Sloane. *Proc. Linn. Soc. N. S. Wales*, v (2), 1890, p. 649. Holotype and Paratype.

Omaseus mastersi Macleay (= *Rhytisternus hopleurus* Chaudoir, 1865). *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 109. Holotype.

Philophloeus brunnipennis Macleay. *Id.*, ii, 1871, p. 89. Holotype and Paratype.

maculatus Macleay. *Id.*, ii, 1871, p. 89. Holotype.

vittatus Macleay. *Id.*, ii, 1871, p. 90. Holotype.

Philoscaphus costalis Macleay. *Id.*, ii, 1873, p. 324. Holotype.

mastersi Macleay. *Id.*, ii, 1871, p. 96. Holotype and Paratype.

Phloeidromus piceus Macleay. *Id.*, ii, 1871, p. 86. Holotype.

Phloeocarabus mastersi Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 85. Holotype and Paratype.

Phorticosomus piceus Sloane. *Proc. Linn. Soc. N. S. Wales*, xl, 1915, p. 465. Holotype and Paratypes.

rugiceps Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 100. Holotype.

Physolesthus grandipalpis Macleay. *Id.*, ii, 1871, p. 121. Holotype.

Plagiotelum opalescens Olliff. *Proc. Linn. Soc. N. S. Wales*, x, 1885, p. 469. Holotype.

Platynus nitidipennis Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 111. Holotype.

planipennis Macleay (= *Colpodes lafertei* Montrouzier, 1860). *Id.*, ii, 1871, p. 112. Holotype.

marginicollis Macleay (= *Europhilus submetallicus* White, 1846). *Id.*, ii, 1871, p. 112. Holotype and Paratype.

Poecilus atronitens Macleay (*Loxandrus*). *Id.*, ii, 1871, p. 110. Holotype and Paratype.

Promecoderus curvipes Sloane. *Proc. Linn. Soc. N. S. Wales*, xlv, 1, 1920, p. 126. Paratype.

distinctus Sloane. *Id.*, v (2), 1890, p. 224. Holotype.

politus Sloane. *Id.*, v (2), 1890, p. 218. Holotype.

viridis Macleay (*Parroa*). *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 99. Holotype.

Sarothrocrepis fasciata Macleay. *Id.*, ii, 1871, p. 88. Holotype.

mastersi Macleay. *Id.*, ii, 1871, p. 87. Holotype.

pallida Macleay. *Id.*, ii, 1871, p. 87. Holotype [Damaged: head and thorax wanting.]

Scaraphites latipennis Macleay. *Id.*, i, 1863, p. 66. Holotype.

Scopodes aeneus Macleay. *Id.*, ii, 1871, p. 91. Holotype.

angulicollis Macleay. *Id.*, ii, 1871, p. 92. Holotype.

auratus Macleay (*Ectinocola*). *Id.*, ii, 1871, p. 92. Holotype.

laevis Macleay. *Id.*, ii, 1871, p. 92. Holotype.

sericeus Macleay (= *S. sigillatus* Germar, 1848). *Id.*, ii, 1871, p. 93. Holotype.

sydneyensis Sloane (= *S. aterrimus* Chaudoir, 1872). *Proc. Linn. Soc. N. S. Wales*, xxviii, 3, 1903, p. 639. Paratype.

Siagonyx amplipennis Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 113. Holotype.

mastersi Macleay. *Id.*, ii, 1871, p. 113. Holotype and Paratype.

Silphomorpha polita Macleay. *Id.*, ii, 1871, p. 93. Holotype and Paratype.

Stenolophus politus Macleay (= *Acupalpus vestigialis* Erichson, 1842). *Id.*, ii, 1871, p. 103. Holotype.

Teraphis convexa Sloane (*Phersita*). *Proc. Linn. Soc. N. S. Wales*, xlv, 1, 1920, p. 158. Paratype.

Tibarisus ater Macleay (*Cratogaster*). *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 106. Holotype and Paratype.

niger Macleay (*Cratogaster*). *Id.*, ii, 1871, p. 107. Holotype and Paratype.

Trechus ater Macleay (*Nemaglossa*). *Id.*, ii, 1871, p. 114. Holotype.

atriceps Macleay (*Nemaglossa*). *Id.*, ii, 1871, p. 113. Holotype.

concolor Macleay (*Nemaglossa*). *Id.*, ii, 1871, p. 114. Holotype.

Xanthophaea chaudoiri Macleay. *Id.*, ii, 1871, p. 84. Holotype and Paratype.

DYTISCIDAE.

Barretthydrus gemmatus Lea. *Rec. South Aus. Mus.*, iii, 3, 1927, p. 279, f. 106. Paratypes.

Copelatus irregularis Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 126. Holotype.

Eunectes punctipennis Macleay (= *Eretes australis* Erichson, 1842). *Id.*, ii, 1871, p. 127. Holotype.

Hydroporus basalis Macleay (*Bidessus*). *Id.*, ii, 1871, p. 124. Holotype.

brunnipennis Macleay (= *Macroporus gardneri* Clark, 1862). *Id.*, ii, 1871, p. 122. Holotype.

fossulipennis Macleay (= *Hyphydrus lyratus* Schwartz, 1808). *Id.*, ii, 1871, p. 122. Holotype.

luridus Macleay (= *Bidessus bistrigatus* Clark, 1862). *Id.*, ii, 1871, p. 124. Holotype.

mastersi Macleay (*Bidessus*). *Id.*, ii, 1871, p. 123. Holotype.

nebulosus Macleay (*Chostonectes*). *Id.*, ii, 1871, p. 123. Holotype.

GYRINIDAE.

Gyrinus convexiusculus Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 128. Holotype.

PAUSSIDAE.

Arthropterus articularis Elston. *Trans. Roy. Soc. South Aust.*, xliii, 1919, p. 342. Holotype.

elongatulus Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 154. Holotype.

kingi Macleay. *Id.*, ii, 1871, p. 154. Holotype.

mastersi Macleay. *Id.*, ii, 1871, p. 153. Holotype.

westwoodi Macleay. *Id.*, ii, 1871, p. 153. Holotype.

CUPIDAE.

Omma mastersi Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 169. Holotype.

HYDROPHILIDAE.

Cyclonotum mastersi Macleay (= *Coelostoma fabricii* Montrouzier, 1860). *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 133. Holotype.

pygmaeum Macleay (*Coelostoma*). *Id.*, ii, 1871, p. 133. Holotype.

Hydatotrephis mastersi Macleay (*Hydrobius*). *Id.*, ii, 1871, p. 130. Holotype.

Hydraena luridipennis Macleay. *Id.*, ii, 1871, p. 133. Holotype.

Hydrobaticus luridus Macleay (= *Heliochares* (*Hydrobaticus*) *tristis* Macleay, 1871). *Id.*, ii, 1871, p. 131. Holotype.

tristis Macleay (*Heliochares*). *Id.*, ii, 1871, p. 131. Holotype.

Hydrochus parallelus Macleay. *Id.*, ii, 1871, p. 133. Holotype.

scabricollis Lea. *Trans. Roy. Soc. South Aust.*, l, 1926, p. 47. Paratype.

serricollis Lea. *Id.*, l, 1926, p. 45. Paratypes.

Hydrophilus gayndahensis Macleay (*Hydrous*). *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 129. Holotype and Paratype.

Hygrotrophus involutus Macleay (*Berosus*). *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 132. Holotype.

Notoberosus zietzi Blackburn. *Trans. Roy. Soc. South Aust.*, xix, 1895, p. 30. Paratype.

Philhydrus elongatulus Macleay (*Enochrus*). *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 130. Holotype.

maculiceps Macleay (*Enochrus*). *Id.*, ii, 1871, p. 130. Holotype.

marmoratus Macleay (*Enochrus*). *Id.*, ii, 1871, p. 130. Holotype.

Pseudohydrobius flavus Lea. *Trans. Roy. Soc. South Aust.*, xliii, 1919, p. 167. Paratypes.

floricola Blackburn. *Id.*, 1898, p. 232. Paratypes.

Sternolophus nitidulus Macleay (= *Hydrobius assimilis* Hope, 1841). *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 139. Holotype and Paratype.

CUCUJIDAE.

Brontes macleayi Olliff (*Uleiota*). *Proc. Linn. Soc. N. S. Wales*, x (2), 1885, p. 218.

Cucujus colonarius Olliff (*Platisus*). *Id.*, x (2), 1885, p. 207. Holotype.

Isaphes bicolor Olliff (= *Platisus colonarius* Oliff, 1885). *Id.*, x (2), 1885, p. 209. Holotype.

Laemophloeus amabilis Olliff. *Id.*, x (2), 1885, p. 211. Holotype.

conterminus Olliff. *Id.*, x (2), 1885, p. 214. Holotype.

macleayi Olliff. *Id.*, x (2), 1885, p. 216. Holotype.

ramsayi Olliff. Id., x (2), 1885, p. 212. Holotype.

rigidus Olliff. *Id.*, x (2), 1885, p. 216. Holotype and Paratype.

Silvanus castaneus Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 168. Holotype.

congenor Olliff (*Oryzaephilus*). *Proc. Linn. Soc. N. S. Wales*, x (2), 1885, p. 223. Holotype.

COLYDIIDAE.

Bitoma cylindrica Carter & Zeck. *Proc. Linn. Soc. N. S. Wales*, lxii, 3–4, 1937, p. 182, pl. vii, f. 4. Holotype.

Bothrideres kreffti Macleay (= *B. equinus* Pascoe, 1862). *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 166. Holotype.

mastersi Macleay. *Id.*, ii, 1871, p. 166. Holotype.

pascoei Macleay (= *B. equinus* Pascoe, 1862). *Id.*, ii, 1871, p. 166. Holotype.

suturalis Macleay (= *B. vittatus* Newman, 1842). *Id.*, ii, 1871, p. 167. Holotype.

Bupala fasciata Carter and Zeck. *Proc. Linn. Soc. N. S. Wales*, lxii, 3–4, 1937, p. 191, pl. ix, f. 13. Holotype.

Cebia communis Carter and Zeck. *Id.*, lxii, 3–4, 1937, p. 194. Holotype and Paratype.

Cryptamorpha optata Olliff. *Id.*, x (2), 1885, p. 221. Holotype.

Deretaphrus incultus Carter and Zeck. *Id.*, lxii, 3–4, 1937, p. 201. Holotype.

pascoei Macleay (= *D. ignarus* Pascoe, 1862). *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 165. Holotype.

costata Macleay. *Id.*, ii, 1871, p. 165. Holotype.

Euclarkia costata Lea. *Trans. Roy. Soc. South Aust.*, xliii, 1919, p. 180, fig. Paratypes.

Gempylodes tinctus Olliff. *Mem. Aust. Mus.*, ii, 1887, p. 81. Holotype.

Hiketes costatus King (*Nepharis*). *Trans. Ent. Soc. N. S. Wales*, ii, 1869, p. 77. Holotype.

Larinotus umbilicatus Carter and Zeck. *Proc. Linn. Soc. N. S. Wales*, lxii, 3–4, 1937, p. 186, pl. viii, f. 12. Holotype.

Neotrichus acanthacollis Carter and Zeck. *Id.*, lxii, 3–4, 1937, p. 195, pl. ix, f. 15. Holotype.

lucifugus Olliff. *Mem. Aust. Mus.*, ii, 1889, p. 82. Holotype.

Phormosa epitheca Olliff. *Id.*, ii, 1889, p. 83. Holotype.

notata Carter and Zeck. *Proc. Linn. Soc. N. S. Wales*, lxii, 3–4, 1937, p. 189, pl. viii, f. 11. Holotype.

Pycnomerus moestus Olliff. *Mem. Aust. Mus.*, ii, 1889, p. 83. Holotype.

Todima fulvicincta Elston. *Trans. Roy. Soc. South Aust.*, xliv, 1922, p. 310, f. 2. Holotype and Paratype.

TROGOSITIDAE.

Ancyrona aegra Olliff. *Proc. Linn. Soc. N. S. Wales*, x (2), 1885, p. 711. Holotype.

amica Olliff. *Proc. Linn. Soc. N. S. Wales*, x (2), 1885, p. 713. Holotype.

latebrosa Olliff. *Id.*, x (2), 1885, p. 712. Holotype.

laticeps Olliff. *Id.*, x (2), 1885, p. 710. Holotype.

vesca Olliff. *Id.*, x (2), p. 713. Holotype.

Leperina burnettensis Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 164. Holotype.

conspicua Olliff. *Proc. Linn. Soc. N. S. Wales*, x (2), 1885, p. 704. Holotype.

fraterna Olliff. *Id.*, x (2), 1885, p. 707. Holotype.

mastersi Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 163. Holotype.

seposita Olliff. *Proc. Linn. Soc. N. S. Wales*, x (2), 1885, p. 702. Holotype.

Ostoma pudicum Olliff. *Mem. Aust. Mus.*, ii, 1889, p. 82, p. vi, f. 7. Holotype and Paratypes.

Phycosecis hilli Lea. *Mem. Qld. Mus.*, vii, 3, 1921, p. 188. Paratype.

Soronia varigata Macleay (*Neaspis*). *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 161. Holotype.

NITIDULIDAE.

Aethinodes variabile Lea. *Mem. Qld. Mus.*, vii, 3, 1921, p. 187. Paratype.

Brachypeplus murrayi Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 159. Holotype.

Carpophilus aterrimus Macleay. *Id.*, ii, 1871, p. 161. Holotype.

convexiusculus Macleay. *Id.*, ii, 1871, p. 159. Holotype.

luridipennis Macleay. *Id.*, ii, 1871, p. 160. Holotype.

obscurus Macleay. *Id.*, ii, 1871, p. 160. Holotype.

pilipennis Macleay. *Id.*, ii, 1871, p. 160. Holotype.

Circopes castaneus Lea. *Mem. Qld. Mus.*, vii, 3, 1921, p. 186. Paratypes.

vagans Lea. *Id.*, vii, 3, 1921, p. 185. Paratypes.

Cychramus niger Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 163. Holotype.

picticollis Lea. *Mem. Qld. Mus.*, vii, 3, 1921, p. 182. Paratype.

Ips politus Macleay (*Glischrochilus*). *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 163. Holotype.

Nitidula concolor Macleay (*Macroura*). *Id.*, ii, 1871, p. 162. Holotype.

Pocadius pilistriatus Macleay. *Id.*, ii, 1871, p. 162. Holotype.

Pria rubricunda Macleay. *Id.*, ii, 1871, p. 161. Holotype.

MYCETOPHAGIDAE.

Tiphyllus fasciatus Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 170. Holotype.

EROTYLIDAE.

Diplocoelus dilataticollis Lea. *Mem. Qld. Mus.*, vii, 3, 1921, p. 237. Paratype.
ovatus Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 170. Holotype.
platysomus Lea. *Rec. South Aus. Mus.*, ii, 2, 1922, p. 298. Paratype.
Episcaphula flavofasciata Lea. *Mem. Qld. Mus.*, vii, 3, 1921, p. 231. Paratypes.
rufolineata Wilson. *Proc. Roy. Soc. Vic.*, xxxiv (N.S.), 1, 1921, p. 35. Paratype.
Thallis melancholica Lea. *Mem. Qld. Mus.*, vii, 3, 1921, p. 234. Paratypes.

PHALACRIDAE.

Litochrus apiciflavus Lea. *Rec. South Aus. Mus.*, iv, 4, 1932, p. 453, f. 32, 79–81. Paratype.
majorinus Lea. *Id.*, iv, 4, 1932, p. 450, f. 26–27, 70–71. Paratype.
Parasemus australiae Lea. *Id.*, iv, 4, 1932, p. 464, f. 37–39. Paratype.
haploderus Lea. *Id.*, iv, 4, 1932, p. 466, f. 45–46. Paratype.
obsoletus Blackburn. *Trans. Roy. Soc. South Aust.*, xix, 1895, p. 213. Paratype.
tasmaniae Lea. *Rec. South Aust. Mus.*, iv, 4, 1932, p. 465, f. 40–41. Paratype.

GEORYSSIDAE.

Georyssus australis King. *Trans. Ent. Soc. N. S. Wales*, i, 1864, p. 158, pl. 14. Holotype.
kingi Macleay. *Id.*, ii, 1871, p. 172. Holotype.
Georyssus occidentalis Carter. *Proc. Linn. Soc. N. S. Wales*, lvii, 3–4, 1932, p. 101. Holotype.

BOSTRYCHIDAE.

Bostrychus bispinosus Macleay (*Xylobosca*). *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 276. Holotype and Paratype.
cylindricus Macleay (*Xylion*). *Id.*, ii, 1871, p. 277. Holotype.
Rhyzopertha gibbicollis Macleay (*Xylosocus*). *Id.*, ii, 1871, p. 276. Holotype.

HETEROCERIDAE.

Heterocerus mastersi Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 173. Holotype.

ENDOMYCHIDAE.

Erotendomychus bimaculatus Lea. *Rec. South Aust. Mus.*, ii, 2, 1922, p. 303, pl. iv, f. 10. Paratype.
Geoendomychus pubescens Lea. *Id.*, ii, 2, 1922, p. 304. Paratype.
Stenotarsus pisoniae Lea (*Endomychus*). *Mem. Qld. Mus.*, vii, 3, 1921, p. 239. Paratype.

COCCINELLIDAE.

Rhizobius filicis Lea. *Trans. Roy. Soc. South Aust.*, liii, 1929, p. 242. Paratype.
nigrovarius Lea. *Proc. Roy. Soc. Vic.*, xx (N.S.), 2, 1909, p. 204. Paratype.
noctuabundus Lea. *Trans. Roy. Soc. South Aust.*, xxxviii, 1914, p. 454. Paratype.
viridipennis Lea. *Id.*, liii, 1929, p. 242. Paratype.
Scymnus variiceps Lea. *Id.*, 1929, p. 244. Paratype.

CORYLOPHIDAE.

Aphanocephalus bimaculatus Lea. *Mem. Qld. Mus.*, vii, 3, 1921, p. 240. Paratype.
potamophilus Lea. *Proc. Linn. Soc. N. S. Wales*, xlvi, 3, 1921, p. 369. Paratype.

DERMESTIDAE.

Anthrenus nigricans Macleay (*Thaumaglossa*). *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 171. Holotype.

Cryptorhopalum obscurum Macleay. *Id.*, ii, 1871, p. 171. Holotype.

Megatoma apicalis Macleay. *Id.*, ii, 1871, p. 170. Holotype.

Trinodes globosus Macleay. *Id.*, ii, 1871, p. 171. Holotype.

punctipennis Macleay. *Id.*, ii, 1871, p. 171. Holotype.

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Aspidiophorus nigriclavus Lea. *Rec. South Aust. Mus.*, i, 3, 1920, p. 280. Paratypes.

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quinquenotatus Lea. *Id.*, xli, 1917, p. 140, pl. xiii, f. 23, 49–50. Paratype.

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Aulicus foveicollis Macleay (*Phlogistus*). *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 272. Holotype and Paratype.

rufipes Macleay (*Phlogistus*). *Id.*, ii, 1872, p. 272. Holotype.

Cleromorpha albohirta Elston. *Trans. Roy. Soc. South Aust.*, liii, 1929, p. 348. Holotype.

ruficollis Elston. *Id.*, liii, 1929, p. 349. Holotype.

Clerus apicalis Macleay (*Phlogistomorpha*). *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 271. Holotype.

mastersi Macleay (*Phlogistomorpha*). *Id.*, ii, 1872, p. 271. Holotype and Paratype. [Paratype lacking head and thorax.]

Cylidrus basalis Macleay. *Id.*, ii, 1872, p. 268. Holotype and Paratype.

Eleale aenea Elston. *Trans. Roy. Soc. South Aust.*, xlvi, 1922, p. 317. Holotype.

amoena Elston. *Id.*, xlv, 1921, p. 157. Holotype and Paratypes.

angularis Elston. *Id.*, xlv, 1921, p. 161. Holotype.

apicalis Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 274. Holotype and Paratype.

carinaticollis Elston. *Trans. Roy. Soc. South Aust.*, xlv, 1921, p. 152. Holotype.

elongatula Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 274. Holotype and Paratype.

fasciata Macleay. *Id.*, ii, 1872, p. 273. Holotype and Paratype. [Paratype wanting head and thorax.]

globicollis Elston. *Trans. Roy. Soc. South Aust.*, xlv, 1921, p. 162. Paratype.

hirticollis Elston. *Id.*, xlv, 1921, p. 165. Holotype and Paratype.

illaetabilis Elston. *Id.*, xlv, 1921, p. 153. Holotype and Paratypes.

latipennis Elston. *Id.*, xlv, 1921, p. 163. Holotype and Paratype.

margaritacea Elston. *Id.*, xlv, 1921, p. 154. Paratypes.

pallidipennis Elston. *Id.*, xlv, 1921, p. 151. Paratype.

parollela Elston. *Id.*. xlv, 1921, p. 159. Holotype and Paratype.

perplexa Elston. *Id.*, xlv, 1921, p. 164. Paratypes.

reticulata Elston. *Id.*, xlv, 1921, p. 158. Holotype and Paratype.

robusta Elston. *Id.*, xlv, 1921, p. 155. Holotype and Paratype.

spinicornis Elston. *Id.*, xlv, 1921, p. 160. Paratypes.

viridicollis Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 274. Holotype and Paratype.

Lemidia auricoma Elston. *Trans. Roy. Soc. South Aust.*, xliii, 1919, p. 344. Paratype.

basiflava Elston. *Id.*, xliii, 1919, p. 343. Paratypes.

basiflava Elston var. *fasciata* Elston. *Id.*, xliii, 1919, p. 344. Paratype.

eborea Elston. *Id.*, l, 1926, p. 280. Paratype.

flavicollis Elston. *Id.*, xliii, 1919, p. 346. Paratype.

miniatula Elston. *Id.*, l, 1926, p. 281. Holotype.

variabilis Elston. *Id.*, xliii, 1919, p. 345. Paratype.

wilsoni Elston. *Id.*, l, 1926, p. 281. Holotype.

Natalis mastersi Macleay (*Eunatalis*). *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 269. Holotype.

Odontophlogistus similis Elston. *Trans. Roy. Soc. South Aust.*, liii, 1929, p. 349. Holotype.

Opilus incertus Macleay (*Opilo*). *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 269. Holotype.

Orthrius duplopunctatus Elston. *Trans. Roy. Soc. South Aust.*, xlvii, 1923, p. 212, pl. xv, f. 2. Holotype.

Phlogistus agraphus Elston. *Id.*, xlvi, 1922, p. 312. Holotype and Paratype.

conspiciendus Elston. *Id.*, l, 1926, p. 282. Paratype.

leucosmus Elston. *Id.*, xlvi, 1922, p. 314. Holotype.

rubriventris Elston (*Odontophlogistus*). *Id.*, xlvi, 1922, p. 313. Holotype and Paratype.

Phlogistus ungulatus Elston (*Odontophlogistus*). *Id.*, xlvi, 1922, p. 314. Holotype and Paratypes.

Pylus okei Elston. *Id.*, liii, 1929, p. 351. Holotype.

pallipes Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 275. Holotype.

Pylusopus chrysocome Elston. *Trans. Roy. Soc. South Aust.*, liii, 1929, p. 352. Holotype and Paratype.

Stigmatium laevius Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 270. Holotype and Paratype.

mastersi Macleay. *Id.*, ii, 1872, p. 269. Holotype and Paratype.

ventrale Macleay. *Id.*, ii, 1872, p. 270. Holotype and Paratype.

Tarsostenodes leucogramma Elston. *Trans. Roy. Soc. South Aust.*, xlvi, 1922, p. 316. Holotype and Paratypes.

Tarsosternus mastersi Macleay (*Tarsostenus*). *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 273. Holotype.

pulcher Macleay (*Tarsostenodes*). *Id.*, ii, 1872, p. 272. Holotype.

Tenerus parvus Elston. *Trans. Roy. Soc. South Aust.*, liii, 1929, p. 351. Holotype.

ruficollis Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 275. Holotype.

tumidicollis Elston. *Trans. Roy. Soc. South Aust.*, liii, 1929, p. 350. Holotype.

Thanasimus sculptus Macleay (*Phlogistus*). *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 271. Holotype and Paratype.

Trogodendron tenebricosum Elston. *Trans. Roy. Soc. South Aust.*, xlv, 1921, p. 147. Holotype.

LYMEXYLONIDAE.

Hylecoetus pervagus Olliff. *Mem. Aust. Mus.*, ii, 1889, p. 87. Holotype.

DASCYLLIDAE.

Dascillus brevicornis Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 313. Holotype. [Wanting abdomen.]

oblongus Carter (*Epilichas*). *Proc. Linn. Soc. N. S. Wales*, lv, 5, 1930, p. 549. Holotype.

serraticornis Carter (*Epilichas*). *Id.*, liv, 2, 1929, p. 72. Holotype.

Elodes davidsoni Carter. *Id.*, lx, 3–4, 1935, p. 192. Holotype.

Epilichas varigatus Carter. *Id.*, lx, 3–4, 1935, p. 187. Holotype.

Macrohelodes montanus Lea. *Trans. Roy. Soc. South Aust.*, xliii, 1919, p. 250. Paratype.

vittatus Carter. *Proc. Linn. Soc. N. S. Wales*, lx, 3–4, 1935, p. 189. Holotype.

Notodascillus sublineatus Carter. *Id.*, lx, 3–4, 1935, p. 186, f. 2. Holotype.

Trichelodes delicatula Carter. *Id.*, lx, 3–4, 1935, p. 189, f. 1. Holotype.

RHIPIDOCERIDAE.

Psacus mastersi Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 313. Holotype.

PTINIDAE.

Anapestus kreusleri King (*Ectrephes*). *Trans. Ent. Soc. N. S. Wales*, i, 1866, p. 317, pl. xvi, f. 1. Holotype.

Diphobia familiaris Olliff. *Proc. Linn. Soc. N. S. Wales*, x (2), 1886, p. 838. Holotype.

Diplocotes foveicollis Olliff. *Id.*, x (2), 1886, p. 839. Holotype.

Dorcatoma corticalis Lea. *Trans. Roy. Soc. South Aust.*, xlviii, 1924, p. 57. Paratype.

punctilatera Lea. *Id.*, xlviii, 1924, p. 62, f. 37. Paratypes.

Dryophiloides albatus Lea. *Id.*, xlviii, 1924, p. 33. Paratypes.

apicipennis Lea. *Id.*, xlviii, 1924, p. 27. Paratype.

basicollis Lea. *Id.*, xlviii, 1924, p. 24. Paratype.

brunneipennis Lea. *Id.*, xlviii, 1924, p. 27. Paratype.

Dryophiloides flavipalpis Lea. *Id.*, xlviii, 1924, p. 30. Paratype.
latipennis Lea. *Id.*, xlviii, 1924, p. 34. Paratypes.
latus Lea. *Id.*, xlviii, 1924, p. 22. Paratype.
melanostethus Lea. *Id.*, xlviii, 1924, p. 31. Paratype.
subcylindricus Lea. *Id.*, xlviii, 1924, p. 31. Paratype.
subcylindricus Lea var. *brunneus* Lea. *Id.*, xlviii, 1924, p. 32. Paratype.
subhumeralis Lea. *Id.*, xlviii, 1924, p. 29. Paratype.
ubiquitosus Lea. *Id.*, xlviii, 1924, p. 35. Paratypes.
vigilans Lea. *Id.*, xlviii, 1924, p. 36. Paratypes.
Enasiba tristis Olliff. *Proc. Linn. Soc. N. S. Wales*, x (2), 1886, p. 839. Holotype.
Pronus marmoratus Lea. *Trans. Roy. Soc. Aust.*, xlviii, 1924, p. 51. Paratype.
subhumeralis Lea. *Id.*, xlviii, 1924, p. 51. Paratypes.
Ptinus adeps Olliff. *Proc. Linn. Soc. N. S. Wales*, x (2), 1886, p. 834. Holotype.
albomaculatus Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 276. Holotype.
attritus Olliff. *Proc. Linn. Soc. N. S. Wales*, x (2), 1886, p. 835. Holotype.
australiae Lea. *Trans. Roy. Soc. South Aust.*, xlvii, 1923, p. 356. Paratypes.
egenus Olliff. *Proc. Linn. Soc. N. S. Wales*, x (2), 1886, p. 836. Holotype.
eminens Olliff. *Id.*, x (2), 1886, p. 834. Holotype.
longus Olliff. *Id.*, x (2), 1886, p. 837. Holotype.
Secretipes xanthorrhoeae Lea. *Trans. Roy. Soc. South Aust.*, xlviii, 1924, p. 43, f. 14, 19. Paratype.
Trypopitys multimaculatus Lea. *Id.*, xlviii, 1924, p. 41. Paratype.

DRYOPIDAE.

Austrolimnius atriceps Carter and Zeck. *Aust. Zool.*, vii, 3, 1932, p. 203, pl. xii, f. 6. Holotype.
diemenensis Carter and Zeck. *Id.*, viii, 2, 1935, p. 79, pl. vii, f. 1. Holotype.
luridus Carter and Zeck. *Id.*, vi, 1, 1929, p. 62, pl. vi, f. 78. Holotype.
oblongus Carter and Zeck. *Id.*, vii, 5, 1933, p. 372, pl. xix, f. 5. Holotype.
suffusus Carter and Zeck. *Id.*, viii, 2, 1935, p. 80, pl. vii, f. 2. Holotype.
variabilis Carter and Zeck. *Id.*, vii, 3, 1932, p. 203, pl. xii, f. 8. Holotype.
victoriensis Carter and Zeck. *Id.*, vi, 1, 1929, p. 61, pl. ii, f. 10. Holotype.
Coxelmis trinotata Carter and Zeck. *Id.*, vi, 1, 1929, p. 67, pl. iv, f. 28. Holotype.
Elmis montanus King (*Austrolimnius*). *Trans. Ent. Soc. N. S. Wales*, i, 1864, p. 160. Holotype.
metallicus King (*Kingolus*). *Id.*, i, 1864, p. 160. Holotype.
novemnotatus King (*Coxelmis*). *Id.*, i, 1864, p. 159. Holotype.
politus King (*Austrolimnius*). *Id.*, i, 1864, p. 160. Holotype and Paratype.
Helmis barretti Carter (*Notriolus*). *Proc. Linn. Soc. N. S. Wales*, li, 4, 1926, p. 506. Holotype and Paratype.
cupreus Carter (*Kingolus*). *Id.*, li, 4, 1926, p. 507. Holotype.
maculatus Carter (*Notriolus*). *Id.*, li, 4, 1926, p. 507. Holotype and Paratype.
purpurea Carter (*Simsonia*). *Id.*, li, 4, 1926, p. 508. Holotype.
quadriplagiata Carter (*Notriolus*). *Id.*, li, 2, 1926, p. 63. Paratype.
Kingolus flavoplagiatus Carter and Zeck. *Aust. Zool.*, vi, 1, 1929, p. 54, pl. i, f. 3. Paratype.
flavosignatus Carter and Zeck. *Id.*, vi, 1, 1929, p. 55. Holotype.
heroni Carter and Zeck. *Id.*, vi, 1, 1929, p. 56, pl. vi, f. 75. Holotype.
tinctus Carter and Zeck. *Id.*, vi, 1, 1929, p. 57, pl. i, f. 7. Holotype.
tyrrhenus Carter and Zeck. *Id.*, vi, 1, 1929, p. 56, pl. i, f. 6. Holotype and Allotype.
yarrensis Carter and Zeck. *Id.*, vi, 1, 1929, p. 57. Holotype.
Limnius quattuormaculatus King (*Kingolus*). *Trans. Ent. Soc. N. S. Wales*, i, 1864, p. 161. Holotype and Paratypes.

Lutochrus australis King (*Hydrethus*). *Id.*, i, 1864, p. 159. Holotype.

Notriolus davidsoni Carter and Zeck. *Aust. Zool.*, viii, 3, 1936, p. 156, pl. xi, f. 1, 6. Holotype.

dorrigoensis Carter and Zeck. *Id.*, vi, 1, 1929, p. 64, pl. vii, f. 81. Holotype and Paratype.

galstonius Carter and Zeck. *Id.*, vi, 1, 1929, p. 65, pl. vii, f. 82. Holotype.

humeralis Carter and Zeck. *Id.*, vi, 1, 1929, p. 65, pl. iv, f. 25. Holotype.

minor Carter and Zeck. *Id.*, vii, 3, 1932, p. 204. Holotype.

minutus Carter and Zeck. *Id.*, ix, 2, 1938, p. 171, pl. xiv, f. 1, 5. Holotype.

setosus Carter and Zeck. *Id.*, viii, 3, 1936, p. 156. Holotype.

subplanatus Carter and Zeck. *Id.*, vi, 1, 1929, p. 66, pl. vii, f. 83. Holotype.

taylori Carter and Zeck. *Id.*, viii, 3, 1936, p. 157, fig. Holotype and Paratype.

tropicus Carter and Zeck. *Id.*, ix, 2, 1938, p. 171, pl. xiv, f. 4, 8. Holotype.

victoriae Carter and Zeck. *Id.*, vi, 1, 1929, p. 66, pl. ii, f. 12. Holotype.

Simsonia allmani Carter and Zeck. *Id.*, viii, 3, 1936, p. 158, pl. xi, f. 4. Holotype.

angusta Carter and Zeck. *Proc. Linn. Soc. N. S. Wales*, li, 2, 1926, p. 62. Holotype.

brooksi Carter and Zeck. *Aust. Zool.*, ix, 2, 1938, p. 170, pl. xiv, f. 3, 9. Holotype.

cotterensis Carter and Zeck. *Id.*, vii, 5, 1933, p. 371, pl. xix, f. 1. Paratype.

hopsoni Carter and Zeck. *Id.*, vi, 1, 1929, p. 58, pl. iii, f. 24. Holotype.

irregularis Carter and Zeck. *Id.*, vi, 1, 1929, p. 60, pl. ii, f. 14. Holotype.

longipes Carter and Zeck. *Id.*, vii, 5, 1933, p. 371, pl. xix, f. 3. Holotype.

Stetholus elongatus Carter and Zeck. *Id.*, vi, 1, 1929, p. 53, pl. ii, f. 16. Holotype.

laticeps Carter and Zeck. *Id.*, vii, 3, 1932, p. 202. Holotype.

BUPRESTIDAE.

Agrilus bispinosus Carter. *Proc. Linn. Soc. N. S. Wales*, xlix, 2, 1924, p. 28. Holotype.

deauratus Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 249. Holotype.

mastersi Macleay. *Id.*, ii, 1872, p. 249. Holotype.

semiviridis Carter. *Proc. Linn. Soc. N. S. Wales*, xlix, 2, 1924, p. 29. Holotype.

Anilara subimpressa Carter. *Id.*, lxi, 1–2, 1936, p. 104. Holotype ♂.

Anthaxia cupripes Macleay (*Neotorresita*). *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 242. Holotype and Paratype.

nigra Macleay (= *Pseudanilara purpureicollis* Macleay, 1872). *Id.*, ii, 1872, p. 243. Holotype.

purpureicollis Macleay (*Pseudanilara*). *Id.*, ii, 1872, p. 242. Holotype.

Aphanisticus browni Carter. *Proc. Linn. Soc. N. S. Wales*, xlix, 2, 1924, p. 32. Holotype.

Astraeus mastersi Macleay (= *A. samouelli* Hope, 1868, var. *mastersi* Macl.). *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 239. Holotype.

Bubastes subflavipennis Carter. *Trans. Roy. Soc. South Aust.*, lxi, 1937, p. 122, pl. v, f. 1. Holotype.

Buprestodes coruscans Carter. *Proc. Linn. Soc. N. S. Wales*, xlix, 2, 1924, p. 24. Holotype ♀.

varigata Carter. *Id.*, xlix, 2, 1924, p. 24. Holotype ♂.

Chrysobothris coelatus Carter. *Id.*, l, 3, 1925, p. 227. Holotype ♂ and Paratype ♀.

mastersi Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 247. Holotype.

octomaculata Carter. *Proc. Linn. Soc. N. S. Wales*. l, 3, 1925, p. 228. Holotype.

saundersi Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 246. Holotype and Paratype.

viridis Macleay. *Id.*, ii, 1872, p. 247. Holotype and Paratype.

Cisseis aurocyanea Carter. *Proc. Linn. Soc. N. S. Wales*, lix, 3–4, 1934, p. 258. Holotype.

browni Carter. *Id.*, lix, 3–4, 1934, p. 258. Holotype.

dimidiata Macleay (= *Ethon chrysopygia* Germar, 1848). *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 248. Holotype and Paratype.

Cisseis elliptica Carter. *Proc. Linn. Soc. N. S. Wales*, xlviii, 2, 1923, p. 170. Holotype.

goerlingi Carter. *Id.*, lxi, 1–2, 1936, p. 104. Holotype.

heroni Carter. *Id.*, lix, 3–4, 1934, p. 259. Holotype ♂.

impressicollis Macleay (= *C. roseocuprea* Hope, 1846). *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 248. Holotype.

inflammata Carter. *Proc. Linn. Soc. N. S. Wales*, xlviii, 2, 1923, p. 167. Holotype and Allotype.

laticollis Carter. *Id.*, xlviii, 2, 1923, p. 169. Paratypes.

laticollis Carter var. *cyanopyga* Carter. *Id.*, xlviii, 2, 1923, p. 170. Paratype.

myallae Carter. *Id.*, lix, 3–4, 1934, p. 260. Holotype.

nitidiventris Carter. *Id.*, lix, 3–4, 1934, p. 260. Holotype.

patricia Carter. *Id.*, lx, 3–4, 1935, p. 180. Holotype.

sapphira Carter. *Id.*, lviii, 3–4, 1933, p. 163. Holotype.

sub-bifascialis Carter. *Id.*, lii, 3, 1927, p. 229. Holotype.

tyrrhena Carter. *Id.*, xlviii, 2, 1923, p. 168. Holotype.

viridiaurea Macleay (*Ethon*). *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 248. Holotype and Paratype.

viridipurpurea Carter. *Proc. Linn. Soc. N. S. Wales*, xlix, 2, 1924, p. 27. Holotype.

Coraebus marmoratus Macleay (= *Ethon suturalis* Saunders, 1868). *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 248. Holotype and Paratype.

Curis atrocyanea Carter. *Proc. Linn. Soc. N. S. Wales*, lvii, 3–4, 1932, p. 103. Holotype ♂.

splendens Macleay (*Neocuropsis*). *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 244. Holotype and Paratype.

venusta Carter. *Trans. Roy. Soc. South Aust.*, lxi, 1937, p. 126, pl. vii (col.). Holotype and Allotype.

Diadoxus erythrurus White, 1843, var. *septentrionalis* Carter. *Proc. Linn. Soc. N. S. Wales*, lix, 3–4, 1934, p. 252. Paratype.

Ethon breve Carter. *Id.*, xlviii, 2, 1923, p. 160. Holotype and Allotype.

latipennis Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 247. Holotype and Paratype.

leai Carter. *Proc. Linn. Soc. N. S. Wales*, xlix, 2, 1924, p. 26. Paratype.

roei Saunders, 1868, var. *obscurum* Carter. *Id.*, lix, 3–4, 1934, p. 261. Holotype.

Mastogenius frenchi Théry. *Id.*, liii, 4, 1928, p. 456, fig. Paratype.

Melobasis apicalis Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 241. Holotype.

aurocyanea Carter. *Trans. Roy. Soc. South Aust.*, lxi, 1937, p. 123. Holotype ♂.

azureipennis Macleay (= *M. cyaneipennis* Boheman, 1858). *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 240. Holotype and Paratype.

browni Carter (= *M. rothei* Blackburn, 1887). [? MSS. See note under *cupricauda* Carter.] Paratype.

browni Carter. *Trans. Roy. Soc. South Aust.*, lxi, 1937, p. 124. Holotype.

convexicollis Carter (= *M. cuprina* Kerremans, 1898). [? MSS. See note under *cupricauda* Carter.] Paratypes ♂, ♀.

costata Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 240. Holotype and Paratype.

cupricauda Carter (= *M. igniceps* Saunders, 1876). [Specimens in the Museum Collection bear labels in Mr. Carter's writing giving the synonymy as above. In *Trans. Ent. Soc. Lond.*, 1923, p. 71, re *igniceps*, is the following note: "Before seeing the type I had described this in MSS. for examples in the Sydney and Melbourne Museums".] Paratypes ♂ and ♀.

empyria Olliff. *Mem. Aust. Mus.*, ii, 1889, p. 85. Holotype.

fasciata Carter. *Trans. Ent. Soc. Lond.*, 1923, p. 98. Paratype.

impressa Carter. *Proc. Linn. Soc. N. S. Wales*, lxi, 1–2, 1936, p. 102. Holotype.

Melobasis macleayi Carter (= *M. macleayana* Obenberger, 1930). *Trans. Ent. Soc. Lond.*, 1923, p. 89. Holotype ♂ and Paratypes ♂, ♀.

marlooensis Carter. *Trans. Roy. Soc. South Aust.*, lxi, 1937, p. 124. Holotype ♂.

myallae Carter. *Proc. Linn. Soc. N. S. Wales*, lvii, 3–4, 1932, p. 102. Holotype.

obscura Macleay (*Anilara*). *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 241. Holotype.

pavo Carter. *Proc. Linn. Soc. N. S. Wales*, lx, 3–4, 1935, p. 179. Holotype.

septemplagiata Carter. *Trans. Ent. Soc. Lond.*, 1923, p. 9. Holotype ♂ and Allotype ♀.

uniformis Carter. *Id.*, 1923, p. 87. Paratypes.

vertebralis Carter. *Id.*, 1923, p. 83. Holotype ♂, Allotype ♀, and Paratype ♀.

wanerua Carter. *Proc. Linn. Soc. N. S. Wales*, lxi, 1–2, 1936, p. 103. Holotype.

Nascio chydaea Olliff. *Id.*, i (2), 1886, p. 861. Holotype and Paratype.

multesima Olliff (*Nascioides*). *Id.*, i (2), 1886, p. 863. Holotype.

viridis Macleay (*Nascioides*). *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 239. Holotype and Paratype.

Neobuprestis trisulcata Carter. *Proc. Linn. Soc. N. S. Wales*, lvii, 3–4, 1932, p. 102. Holotype.

Neocuris aenescens Carter. *Id.*, liii, 3, 1928, p. 281. Holotype.

doddi Carter. *Id.*, liii, 3, 1928, p. 281. Holotype.

duboulayi Carter. *Trans. Roy. Soc. South Aust.*, lxi, 1937, p. 122. Holotype ♂ and Allotype ♀.

gracilis Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 241. Holotype.

ignicollis Carter. *Trans. Roy. Soc. South Aust.*, lxi, 1937, p. 122. Holotype ♂.

violacea Carter. *Proc. Linn. Soc. N. S. Wales*, liii, 3, 1928, p. 282. Holotype ♀.

Neospades cupricauda Carter (*Ethon*). *Id.*, lii, 3, 1927, p. 228. Paratypes ♂ and ♀.

gibbera Carter. *Trans. Roy. Soc. South Aust.*, lxi, 1937, p. 121. Holotype.

niveosparsa Carter (*Ethon*). *Proc. Linn. Soc. N. S. Wales*, lii, 3, 1927, p. 228. Holotype.

Notobubastes occidentalis Carter. *Id.*, xlix, 2, 1924, p. 25, f. 5. Holotype.

Notograptus hieroglyphicus Macleay (*Notographus*). *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 244. Holotype.

sulcipennis Macleay. *Id.*, ii, 1872, p. 243. Holotype.

Paracephala browni Carter. *Proc. Linn. Soc. N. S. Wales*, lviii, 3–4, 1933, p. 164. Holotype.

vitticeps Carter. *Id.*, xlix, 4, 1924, p. 535. Holotype ♀.

Polycesta mastersi Macleay (*Polycestella*). *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 246. Holotype.

Stigmodera aeraticollis Carter. *Proc. Linn. Soc. N. S. Wales*, lv, 2, 1930, p. 182. Holotype.

ariel Carter. *Id.*, lv, 5, 1930, p. 533, f. 1. Holotype.

aurantiaca Carter. *Aust. Zool.*, vi, 4, 1931, p. 346, pl. xxx, f. 5. Holotype.

bogania Carter. *Proc. Linn. Soc. N. S. Wales*, lv, 5, 1930, p. 534, f. 3. Holotype ♂.

broomensis Carter. *Id.*, lix, 3–4, 1934, p. 253, f. 1. Holotype ♂.

commixta Carter. *Id.*, xlix, 2, 1924, p. 21. Holotype ♂ and Paratype.

cydista Rainbow. *Rec. Aus. Mus.*, iv, 4, 1904, p. 246, f. 36. Holotype.

desideria Carter. *Trans. Roy. Soc. South Aust.*, xl, 1916, p. 122, pl. x, f. 16–17. Paratype.

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metasternalis Lea. *Trans. Roy. Soc. South Aust.*, xli, 1917, p. 234. Paratype.

octomaculata Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1872, p. 308. Holotype and Paratype.

pygidialis Lea. *Trans. Roy. Soc. South Aust.*, xli, 1917, p. 231, pl. xiv, f. 95–96, pl. xv, f. 126. Paratype.

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zietzi Blackburn (*Sessinia*). *Trans. Roy. Soc. South Aust.*, xix, 1895, p. 55. Paratype.

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erythroderus Lea. *Id.*, xli, 1917, p. 304. Paratype.

fuscicollis Lea. *Id.*, xli, 1917, p. 300. Paratypes.

maritima Lea. *Id.*, xli, 1917, p. 299. Paratypes ♂ and ♀.

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Stenopalpus fuscus Macleay. *Id.*, ii, 1872, p. 311. Holotype.

mastersi Macleay. *Id.*, ii, 1872, p. 312. Holotype and Paratype.

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apicalis Macleay. *Id.*, ii, 1872, p. 311. Holotype.
bizonata Macleay. *Id.*, ii, 1872, p. 311. Holotype.
fuscicornis Macleay. *Id.*, ii, 1872, p. 310. Holotype.
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Eucarteria floralis Lea. *Trans. Roy. Soc. South Aust.*, xxxviii, 1914, p. 252. Paratype.
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muelleri Macleay (*Phalacrognathus*). *Proc. Linn. Soc. N. S. Wales*, x (2), 1885, p. 135. Holotype.
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rudis Lea. *Id.*, 1910, p. 9, f. 34–37, 58. Paratypes.
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politus Carter. *Id.*, xlvi, 3, 1921, p. 302, f. 1–2. Paratypes.

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semicostatus Macleay. *Id.*, ii, 1871, p. 186. Holotype and Paratype.
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tricolor Blackburn. *Trans. Roy. Soc. South Aust.*, xxxiv, 1904, p. 295. Paratype.

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nitidicollis Macleay (*Saprosites*). *Id.*, ii, 1871, p. 185. Holotype.
obscurus Macleay (*Ataenius*). *Id.*, ii, 1871, p. 184. Holotype and Paratype.
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Anodontonyx insularis Lea. *Id.*, xliii, 1919, p. 217. Paratype.
niger Lea. *Id.*, xliii, 1919, p. 219. Paratype.
Aphodius geminatus Macleay (*Pedaria*). *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 183. Holotype.
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Cephalodesmius quadridens Macleay. *Id.*, ii, 1871, p. 176. Holotype and Paratype.

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  obscurus Macleay (= *C. paradoxus* Macleay, 1819). *Id.*, ii, 1871, p. 201. Holotype and Paratype.
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  holosericeus Macleay. *Id.*, ii, 1871, p. 194. Holotype and Paratype.
  infuscatus Macleay. *Id.*, ii, 1871, p. 195. Holotype.
  pubescens Macleay. *Id.*, ii, 1871, p. 194. Holotype and Paratype.
  ruficollis Macleay. *Id.*, ii, 1871, p. 196. Holotype.
  rugosipennis Macleay. *Id.*, ii, 1871, p. 196. Holotype and Paratype.

Homalotropus luridipennis Macleay. *Id.*, ii, 1871, p. 193. Holotype and Paratype.

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  laevipennis Blackburn. *Trans. Roy. Soc. South Aust.*, xx, 1896, p. 240. Paratype.
  puncticollis Macleay. *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 197. Holotype.

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  flavipennis Lea. *Id.*, xli, 1917, p. 545. Paratype.
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  parvulus Macleay . *Id.*, ii, 1871, p. 192. Holotype and Paratypes.
  pilosus Macleay. *Id.*, ii, 1871, p. 190. Holotype and Paratype.
  rufiventris Macleay. *Id.*, ii, 1871, p. 191. Holotype.

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  - *marginalis* Lea. *Id.*, xliii, 1919, p. 232. Paratype.
  - *obscurus* Macleay (= *M. hopeanus* Westwood, 1842). *Trans. Ent. Soc. N. S. Wales*, ii, 1871, p. 188. Holotype and Paratype.
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  - *submetallicus* Lea. *Rec. South Aust. Mus.*, ii, 3, 1923, p. 383. Paratype.
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  - *rectangulus* Blackburn. *Id.*, xix, 1895, p. 41. Paratype.

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versicolor McKeown. *Id.*, ix, 2, 1938, p. 178, pl. xv, f. 7. Holotype and Paratypes.

Aridaeus cleroides McKeown (*Cremys*). *Rec. Aust. Mus.*, xx, 3, 1938, p. 207, pl. xxii, f. 3. Holotype and Allotype.

princeps Carter. *Proc. Linn. Soc. N. S. Wales*, lix, 3–4, 1934, p. 266. Holotype.

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Athemistus aberrans Carter. *Id.*, lvii, 3–4, 1932, p. 113. Holotype.

aborigine Carter. *Id.*, li, 4, 1926, p. 496. Paratype.

barretti Carter. *Id.*, li, 4, 1926, p. 500, f. 4. Holotype.

harrisoni Carter. *Id.*, li, 4, 1926, p. 497. Paratype.

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macleayi Carter. *Id.*, li, 4, 1926, p. 495. Holotype and Paratype.

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tricolor Carter. *Id.*, li, 4, 1926, p. 499. Paratype.

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discopunctata McKeown. *Id.*, xx, 3, 1938, p. 207, pl. xxii, f. 4. Holotype.

occidentalis McKeown. *Id.*, xx, 3, 1938, p. 209, pl. xxiii, f. 3. Holotype.

Ceraegidion dorrigoensis McKeown. *Id.*, xx, 2, 1937, p. 193, f. 1, 3, 4, 1*a*, *b*, *c*. Holotype ♀, Allotype ♂, and Paratypes ♂ and ♀.

Ceresium australe Carter. *Proc. Linn. Soc. N. S. Wales*, lvii, 3–4, 1932, p. 115. Holotype.

procerum Olliff. *Rec. Aust. Mus.*, i, 3, 1890, p. 74, pl. x, f. 3. Holotype.

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Citriphaga mixta Lea. *Agric. Gaz. N. S. Wales*, xxx, 4, 1919, p. 261, f. 1–4. Paratype.

Coptopterus decoratus McKeown. *Rec. Aust. Mus.*, xx, 5, 1940, p. 302, pl. xxxi, fig. 6. Paratype.

hirsutus McKeown. *Id.*, xxi, 2, 1942, p. 86. Holotype ♀ and Allotype ♂.

maculatus McKeown. *Id.*, xx, 5, 1940, p. 304. Holotype.

musgravei McKeown. *Id.*, xx, 5, 1940, p. 303. Holotype ♀.

partitus McKeown. *Id.*, xx, 5, 1940, p. 304. Holotype ♂.

scriptelytron McKeown. *Id.*, xx, 5, 1940, p. 305. Holotype ♂.

stramineous McKeown. *Id.*, xx, 5, 1940, p. 306, pl. xxxi, fig. 3. Holotype ? ♀.

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nigrothorax McKeown. *Id.*, xxi, 2, 1942, p. 104. Holotype.

Didymocantha gracilis McKeown. *Id.*, xxi, 2, 1942, p. 81. Paratype ♂.

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Disterna maculata McKeown. *Rec. Aust. Mus.*, xx, 3, 1938, p. 211, pl. xxii, f. 6. Holotype.

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  divergens Carter. *Id.*, lviii, 3–4, 1933, p. 180. Holotype.
  montana Carter. *Id.*, liii, 5, 1928, p. 548. Paratype.
  rufodorsalis Carter. *Id.*, lvii, 3–4, 1932, p. 114. Holotype and Allotype.

Homaemota tricolor Lea. *Rec. South Aust. Mus.*, i, 1, 1918, p. 94. Paratypes.

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  browni Carter. *Proc. Linn. Soc. N. S. Wales*, lvii, 3–4, 1932, p. 114. Holotype.
  echinatus Carter. *Id.*, li, 4, 1926, p. 504. Holotype ♂ and Allotype ♀.
  tuberculatus Carter. *Id.*, lix, 3–4, 1934, p. 268, f. 5. Holotype.

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Neouracanthus nigroterminatus McKeown. *Rec. Aust. Mus.*, xx, 3, 1938, p. 203, pl. xxii, f. 1. Holotype ♂ and Allotype ♀.

Nerida carabiformis McKeown. *Id.*, xx, 5, 1940, p. 294, pl. xxxii, fig. 3. Holotype.
  intricata McKeown. *Id.*, xx, 5, 1940, p. 294, pl. xxxi, fig. 1. Holotype.

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Notoceresium elongata McKeown. *Rec. Aust. Mus.*, xxi, 2, 1942, p. 82, text-fig. 1. Holotype ♀ and Allotype ♂.
  setistriatus McKeown. *Id.*, xxi, 2, 1942, p. 82, text-fig. 2. Holotype ♀ and Allotype ♂.

Nungena binocularis McKeown. *Id.*, xxi, 2, 1942, p. 96, text-fig. 8. Holotype ♂.

Ochyra coarctata Pasc. var. *polyrhachis* McKeown. *Id.*, xxi, 6, 1945, p. 287. Holotype.

Opsidota gracilis McKeown. *Id.*, xxi, 2, 1942, p. 86, text-fig. 4. Holotype ♀ and Allotype ♂.

Pachydissus sweersensis McKeown. *Id.*, xx, 5, 1940, p. 297. Holotype.

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Penthea adamsae McKeown. *Id.*, xx, 3, 1938, p. 213, pl. xxii, f. 5. Holotype.
  tigrina Blackburn. *Trans. Roy. Soc. South Aust.*, xxv, 1901, p. 37. Paratype.
  lichenosus McKeown. *Rec. Aust. Mus.*, xxi, 2, 1942, p. 103. Holotype ♀ and Allotype ♂.

Phacodes mirabilis McKeown. *Id.*, xx, 5, 1940, p. 297, pl. xxxi, fig. 4. Holotype.

Phantissus citatus McKeown. *Id.*, xx, 5, 1940, p. 307, pl. xxxii, fig. 2. Holotype.

Piesarthrius bleeserae McKeown. *Id.*, xxi, 2, 1942, p. 85. Holotype ♂.
  gearyi McKeown. *Id.*, xx, 5, 1940, p. 300, pl. xxxii, fig. 4. Holotype ♂.
  reticulatus McKeown. *Id.*, xx, 5, 1940, p. 301, pl. xxxi, fig. 2. Holotype ♂.
  rufoflavus McKeown. *Id.*, xx, 5, 1940, p. 301, pl. xxxii, fig. 6. Holotype ♀.

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Porithodes pustulata Carter. *Proc. Linn. Soc. N. S. Wales*, lv, 5, 1930, p. 548. Holotype.

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parvus McKeown. *Id.*, xxi, 2, 1942, p. 89, text-fig. 6. Holotype ♀ and Allotype ♂.

Rhytiphora browni McKeown. *Id.*, xx, 3, 1938, p. 212, pl. xxiii, f. 4. Holotype ♀, Allotype ♂, and Paratypes ♂ and ♀.

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collaris Lea. *Trans. Roy. Soc. South Aust.*, xxxviii, 1914, p. 314. Paratype.
maestus Lea. *Id.*, xl, 1916, p. 355. Paratype.
marmoratus Lea. *Id.*, xxxviii, 1914, p. 315. Paratype.
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Poropterus angustatus Lea. *Id.*, 1897, p. 468. Paratype.
Prophaesia alba Lea. *Proc. Roy. Soc. Vic.*, xxxix (N.S.), 1927, p. 107. Paratype.
Psalidura coxi Macleay. *Trans. Ent. Soc. N. S. Wales*, i, 1865, p. 204. Holotype and Paratype.
falciformis Macleay. *Id.*, i, 1865, p. 213. Holotype ♀ and Allotype ♂.
helyi Macleay (= *P. mirabilis* Kirby, 1818). *Id.*, i, 1865, p. 213. Holotype and Paratype.
howitti Macleay (= *P. mirabilis* Kirby, 1818). *Id.*, i, 1865, p. 211. Holotype and Paratype.
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mastersi Macleay. *Trans. Ent. Soc. N. S. Wales*, i, 1865, p. 214. Holotype.

Psalidura miracula Macleay. *Id.*, i, 1865, p. 205. Holotype.
 mirafica Macleay (= *P. mira* Boheman, 1843). *Id.*, i, 1865, p. 206. Holotype.
 mitchelli Macleay. *Id.*, i, 1865, p. 210. Holotype and Paratype.
 montana Macleay. *Id.*, i, 1865, p. 209. Holotype and Paratype.
 rufolineata Macleay. *Id.*, i, 1865, p. 203. Holotype.
Rhamphus megalops Lea. *Proc. Linn. Soc. N. S. Wales*, l, 4, 1925, p. 427. Paratypes.
 microscopicus Lea. *Id.*, l, 4, 1925, p. 428. Paratype.
Rhinaria carinirostris Lea. *Id.*, liv, 5, 1929, p. 537. Paratypes.
Roptopterus tasmaniensis Lea. *Proc. Roy. Soc. Vic.*, xx (N.S.), 1907, p. 185. Paratype.
Sclerorrhinella granuliceps Ferguson. *Proc. Linn. Soc. N. S. Wales*, xxxviii, 1913, p. 391. Holotype.
Synomus setipennis Lea. *Ent. Mitt.*, xvi, 1927, p. 129. Paratypes.
Talaurinus catenulatus Macleay. *Trans. Ent. Soc. N. S. Wales*, i, 1865, p. 234. Holotype.
 caviceps Macleay. *Id.*, i, 1866, p. 320. Holotype.
 euomioides Macleay. *Id.*, i, 1865, p. 225. Holotype.
 fergusoni Carter. *Trans. Roy. Soc. South Aust.*, lxi, 1937, p. 143. Holotype and Allotype.
 fossulatus Ferguson. *Proc. Linn. Soc. N. S. Wales*, xxxviii, 1913, p. 368. Holotype.
 gayndahensis Ferguson. *Id.*, xxxvii, 1912, p. 131, pl. ii, f. 8. Holotype.
 humeralis Macleay. *Trans. Ent. Soc. N. S. Wales*, i, 1865, p. 224. Holotype.
 impressicollis Macleay. *Id.*, i, 1865, p. 239. Holotype and Paratype.
 incanescens Macleay Macleay, 1865, var. *muricatus* Macleay. *Id.*, i, 1866, p. 321. Holotype.
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 pallidus Macleay. *Trans. Ent. Soc. N. S. Wales*, i, 1865, p. 223. Holotype.
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 parvus Ferguson. *Proc. Linn. Soc. N. S. Wales*, xxxvii, 1912, p. 110. Holotype.
 pulverulentus Macleay. *Trans. Ent. Soc. N. S. Wales*, i, 1865, p. 223. Holotype and Paratype.
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 sphaerulatus Macleay. *Id.*, i, 1865, p. 235. Holotype.
 squamosus Macleay. *Id.*, i, 1865, p. 219. Holotype.
 tuberculatus Macleay. *Id.*, i, 1865, p. 233. Holotype.
 variegatus Macleay. *Id.*, i, 1865, p. 218. Holotype.
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Timareta hamata Lea. *Id.*, xlvi, 1922, p. 300, pl. xiii, f. 4. Paratype.
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 xanthorrohae Lea. *Id.*, xxxiii, 1909, p. 155. Paratype.
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 trianguliferus Lea. *Id.*, xxxvii, 1913, p. 330. Paratype.

TYPES OF EXTRA-AUSTRALIAN COLEOPTERA.

CARABIDAE.

Planetes unicolor Macleay (*Pogonoglossus*). *Proc. Linn. Soc. N. S. Wales*, i (2), 1886, p. 137. Holotype.
Stricklandia pericolloides Macleay. *Id.*, i (2), 1886, p. 139. Holotype.

GYRINIDAE.

Enhydrus froggatti Macleay (*Macrogyrus*). *Proc. Linn. Soc. N. S. Wales*, i (2), 1886, p. 141. Holotype.

HYDROPHILIDAE.

Nosodendron fijiense Lea. *Rec. South Aust. Mus.*, iv, 3, 1931, p. 376. Paratype.

BOSTRYCHIDAE.

Rhizopertha papuensis Macleay. *Proc. Linn. Soc. N. S. Wales*, i (2), 1886, p. 154. Holotype.

STAPHYLINIDAE.

Anomognathus debilis Cameron. *Rec. South Aust. Mus.*, iii, 3, 1927, p. 270. Paratype.

Apheloglossa pacifica Cameron. *Id.*, iii, 3, 1927, p. 268. Paratype.

Atheta fijiana Cameron. *Id.*, iii, 3, 1927, p. 271. Paratype.

Philonthus bicoloratus Cameron. *Id.*, iv, 3, 1931, p. 261. Paratype.

Silusa biplagiata Cameron. *Id.*, iii, 3, 1927, p. 270. Paratype.

Sternotropa brevicornis Cameron. *Id.*, iii, 3, 1927, p. 265. Paratype.

longicornis Cameron. *Id.*, iii, 3, 1927, p. 266. Paratypes.

LYCIDAE.

Calopteron amplipenne Macleay. *Proc. Linn. Soc. N. S. Wales*, i (2), 1886, p. 151. Holotype.

Carphurus cyaneipennis Macleay. *Id.*, i (2), 1886, p. 153. Holotype.

Metriorrhynchus infuscatus Macleay. *Id.*, i (2), 1886, p. 151. Holotype.

serricornis Macleay. *Id.*, i (2), 1886, p. 150. Holotype.

tenuis Macleay. *Id.*, i (2), 1886, p. 150. Holotype.

Trichalus apicalis Macleay. *Id.*, i (2), 1886, p. 152. Holotype.

pallidipennis Macleay. *Id.*, i (2), 1886, p. 152. Holotype.

TENEBRIONIDAE.

Asthosus vanheueni Gebien. *Ind. Or. Neerland. Mem. Mus. Roy. Hist. nat. Belg.*, Hors serie., iv, 11, 1935, p. 58, pl. f. 4. Paratype.

Allecula papuensis Macleay (*Ebenolus*). *Proc. Linn. Soc. N. S. Wales*, i (2), 1886, p. 156. Holotype and Paratype.

Amarygmus convexiusculus Macleay (= *A. niger* Gebien, 1911). *Id.*, i (2), 1886, p. 156. Holotype.

inornatus Macleay (= *A. morio* Fabricius, 1781). *Id.*, i (2), 1886, p. 155. Holotype.

insignis Carter. *Id.*, lv, 5, 1930, p. 542. Paratypes.

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puncticeps Macleay. *Id.*, i (2), 1887, p. 156. Holotype.

viridiaeneus Blair (*Platolenes*). *Proc. Zool. Soc. Lond.*, 1914, p. 19. Paratypes ♀.

Bradymerus semiasperatus Fairmaire. *Ann. Soc. Ent. Belg.*, xxvii, 1883, p. 24. Plesiotype.

Ceropria imaculata Gebien. *Nova Guinea*, Zool., xiii, liv. 3, 1920, p. 256. Paratype.

Chariotheca litigiosa Pascoe. *Journ. Ent.*, i, 1860, p. 126. Plesiotype.

spectabilis Gebien. *Nova Guinea*, Zool., xiii, liv. 3, 1920, p. 348. Paratype.

Diphyrrhynchus meligethoides Gebien. *Id.*, Zool., xiii, liv. 3, 1920, p. 226. Paratype.

Encyalesthus epistomaticus Gebien. *Id.*, Zool., xiii, liv. 3, 1920, p. 301. Paratype.

sinuatipes Gebien. *Id.*, Zool., xiii, liv. 3, 1920, p. 300. Paratype.

Nyctozoilus crenaticollis Macleay. *Proc. Linn. Soc. N. S. Wales*, i (2), 1887, p. 154. Holotype.

Orcopagia angustata Carter. *Id.*, lix, 3–4, 1934, p. 261. Holotype and Paratype.

Osdara plicicollis Fairmaire (*Bradymerus*). *Not. Leyd. Mus.*, xviii, 1896, p. 233. Plesiotype.

Phenus latitarsis Gebien. *Nova Guinea*, Zool., xiii, liv. 3, 1920, p. 326, pl. f. 19. Paratypes.

Prophanes submetallicus Macleay (*Pezophenes*). *Proc. Linn. Soc. N. S. Wales*, i (2), 1887, p. 154. Holotype.

Pseudolyprops longiplicatus Gebien. *Nova Guinea*, Zool., xiii, liv, 3, 1920, p. 315. Paratype.

Setenis amplipennis Gebien. *Id.*, Zool., xiii, liv. 3, 1920, p. 291, pl. ix, f. 14. Paratype.

producta Gebien. *Id.*, Zool., xiii, liv. 3, 1920, p. 293. Paratype.

subfoveatus Gebien. *Id.*, Zool., xiii, liv. 3, 1920, p. 289. Paratype.

Uloma emarginata Montrouzier, 1885, subsp. *hamata* Gebien. *Nova Guinea*, Zool., xiii, liv. 3, 1920, p. 274. Paratype.

pachydera Gebien. *Ind. Or. Neerl. Mem. Mus. Roy. Hist. nat. Belg.*, Hors serie., iv, 11, 1935, p. 59, pl. f. 5. Paratype.

OEDEMERIDAE.

Naceredes transmarina Rainbow. *Mem. Aust. Mus.*, iii, 2, 1897, p. 92, pl. i, f. 6. Holotype and Paratype.

SCARABAEIDAE.

Onthophagus oleipennis Macleay. *Proc. Linn. Soc. N. S. Wales*, i (2), 1886, p. 145. Holotype.

planiceps Macleay. *Id.*, i (2), 1886, p. 145. Holotype and Paratype.

reticollis Macleay. *Id.*, i (2), 1886, p. 145. Holotype.

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Aegomomus ornatus Macleay. *Proc. Linn. Soc. N. S. Wales*, i (2), 1886, p. 197. Holotype and Paratype.

Clytanthus angustulus Macleay (*Chlorophorus*). *Id.*, i (2), 1886, p. 203. Holotype.

Clytus velutinus Macleay (*Xylotrechus*). *Id.*, i (2), 1886, p. 203. Holotype.

Orinoeme rubricollis Macleay. *Id.*, i (2), 1886, p. 199. Holotype and Paratype.

Praonetha bizonata Macleay. *Id.*, i (2), 1886, p. 198. Holotype.

pallida Macleay. *Id.*, i (2), 1886, p. 198. Holotype.

Tmesisternus froggatti Macleay. *Id.*, i (2), 1886, p. 200. Holotype and Paratype.

lateralis Macleay. *Id.*, i (2), 1886, p. 202. Holotype.

lineatus Macleay. *Id.*, i (2), 1886, p. 201. Holotype.

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Ampagia basicollis Lea. *Trans. Ent. Soc. Lond.*, 1929, p. 190, pl. xvi, f. 22. Paratype.

vitiensis Lea. *Id.*, 1929, p. 191, pl. xvi, f. 23. Paratype.

Deretiosus lateroalbus Lea. *Rec. South Aust. Mus.*, iv, 1, 1928, p. 61. Paratype.

Elytrurus squamatus Rainbow (= *Trigonops spongicollis* Fairmaire). *Mem. Aust. Mus.*, iii, 2, 1897, p. 92, pl. i, f. 7. Holotype and Paratype.

Idiotasia cribricollis Lea. *Trans. Roy. Soc. South Aust.*, lii, 1928, p. 156. Paratype.

Micryptorhynchus vitiensis Lea. *Rec. South Aust. Mus.*, iv, 1, 1928, p. 89. Paratype.

Pantoxystus cyaneus Macleay. *Proc. Linn. Soc. N. S. Wales*, i (2), 1886, p. 189. Holotype.

Storeus aurifer Lea. *Mem. Qld. Mus.*, ix, 1, 1927, p. 59, f. 1, p. Paratype.

minimus Lea. *Id.*, ix, 1, 1927, p. 60, f. 1, q. Paratype.

PLATE I.

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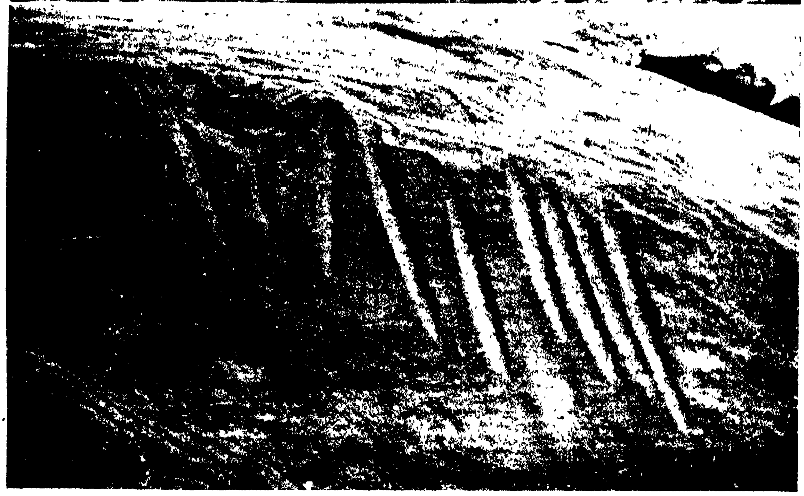

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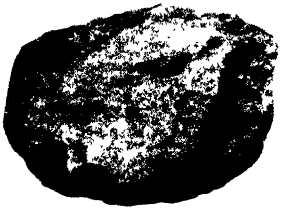
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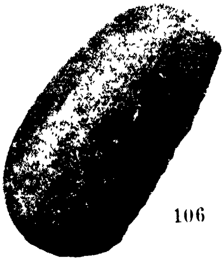
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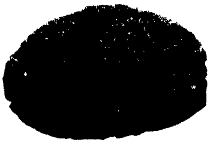
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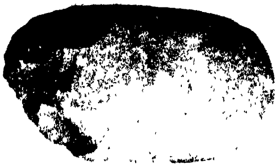
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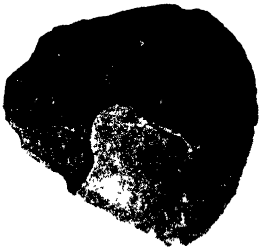
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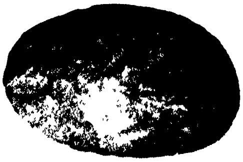
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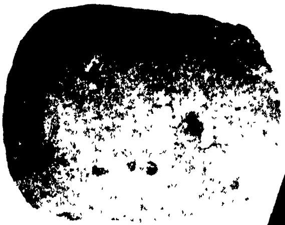
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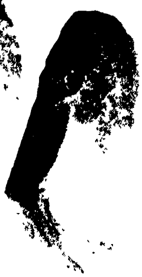
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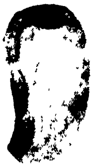
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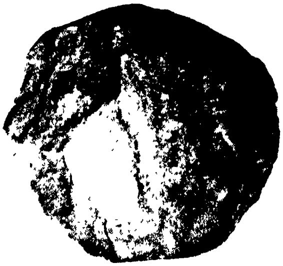
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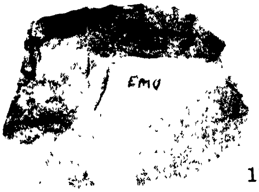

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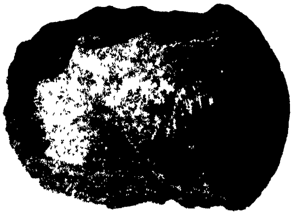
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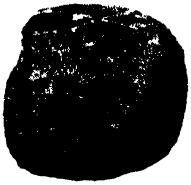
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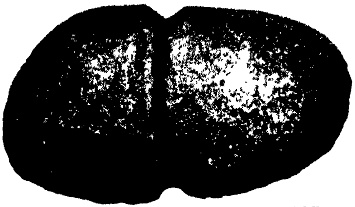
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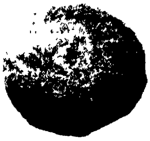
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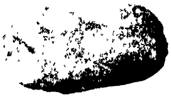
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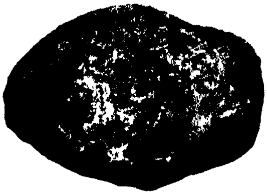
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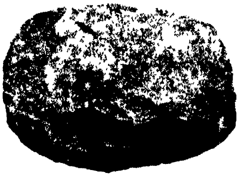
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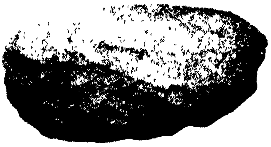
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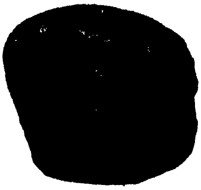
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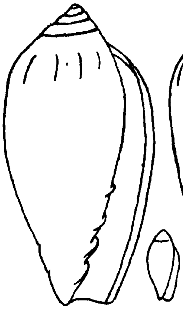
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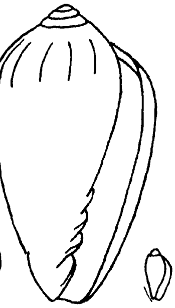
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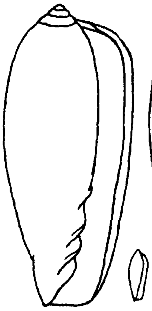
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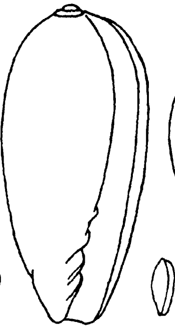
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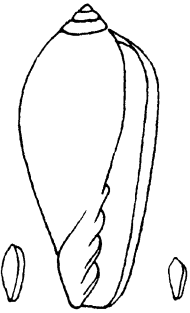
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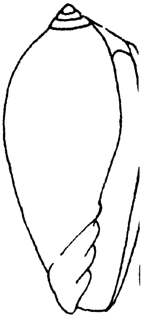
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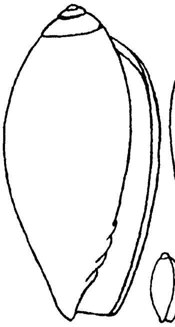
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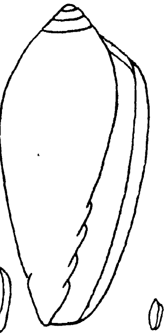
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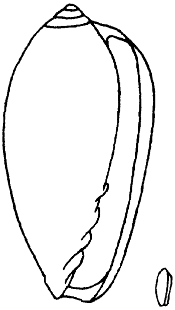
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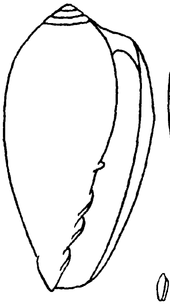
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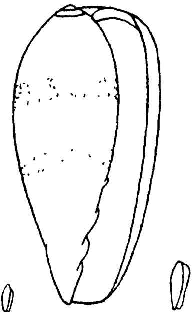
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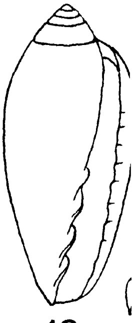
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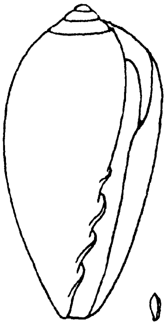
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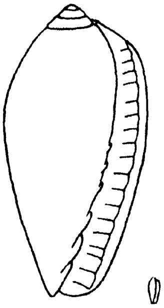
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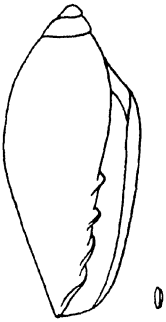
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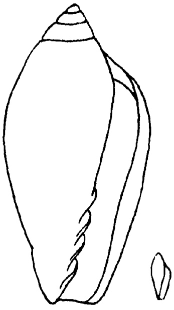
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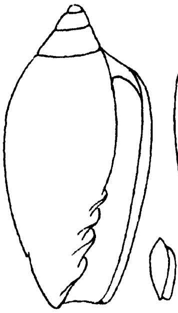
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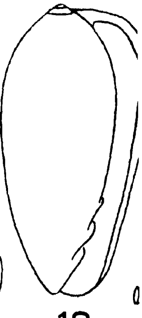
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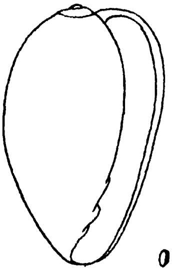
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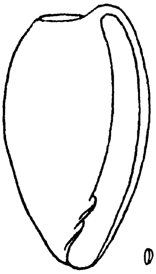
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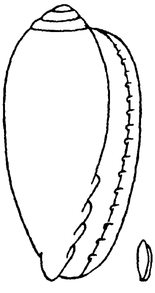
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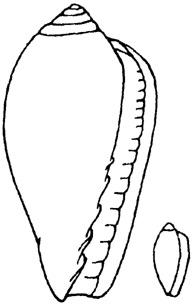
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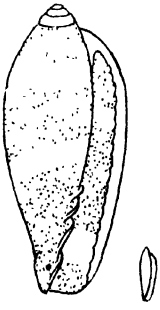
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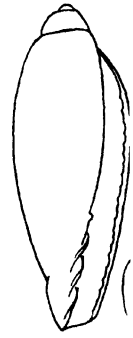
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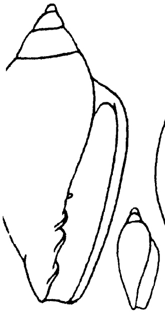
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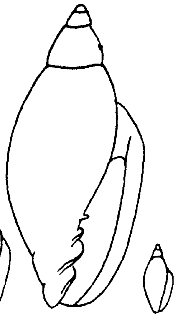
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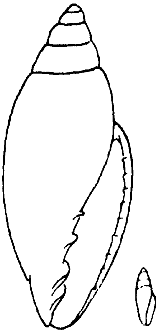
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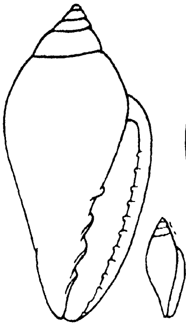
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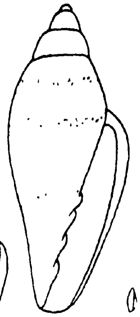
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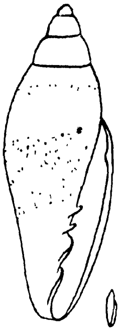
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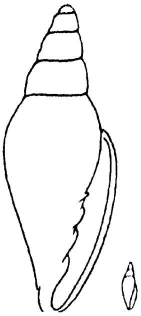
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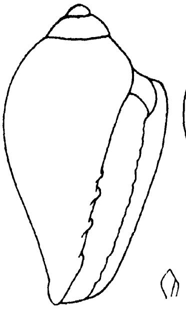
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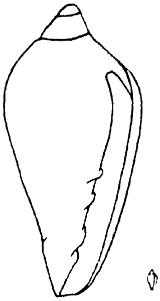
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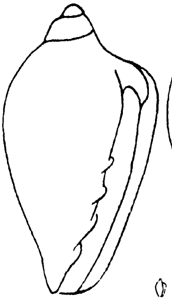
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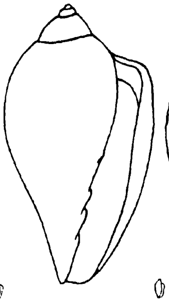
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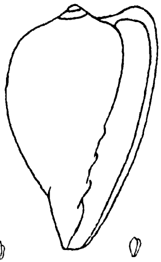
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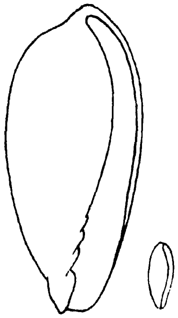
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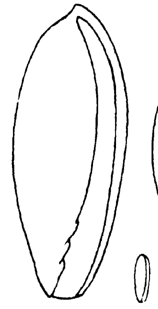
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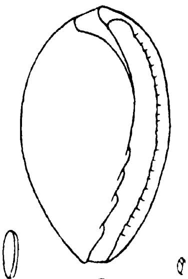
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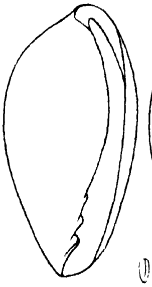
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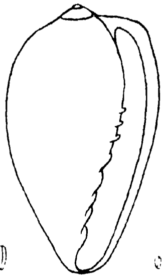
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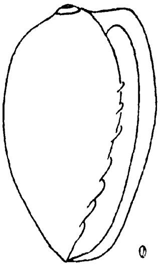
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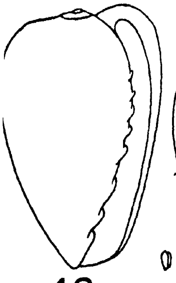
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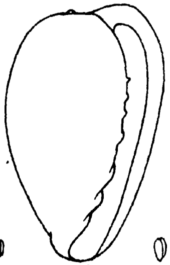
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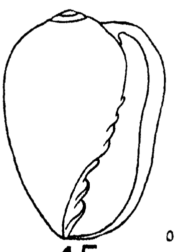
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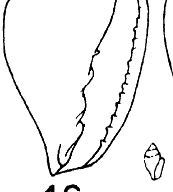
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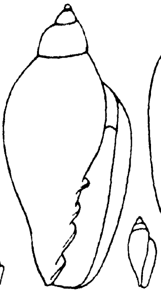
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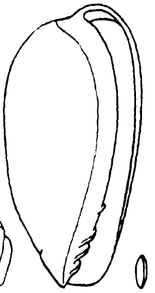
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27 JUN 1949

OPILIONES FROM THE SOLOMON ISLANDS.

By R. R. Forster.
Canterbury Museum, Christchurch, New Zealand.

(Figures 1-16.)

Very little is known of the Opiliones of the Solomon Islands. The only paper dealing with the opilionids of this area is that by Rainbow (*Rec. Aust. Mus.*, v, 10) in which he described one new species (*Liobunum aurum*) and recorded a further species, *Mesoceras spinigerum* Sor., from Russell Island. Through the kindness of Dr. A. B. Walkom, Director, Australian Museum, I have been able to examine Rainbow's material. The specimens determined by him as *Mesoceras spinigerum* Sor. prove to be an undescribed species of *Ibalonius* Karsch, which is described below as *I. rainbowi*, n. sp., while the species described as *Liobunum aurum* is placed in the genus *Gagrella* Stol. and is recorded below as *Gagrella aura* (Rainbow). In addition, a new genus and species of the Phalangodidae from Savo Island and a new species of *Gagrella* Stol. from Cape Esperance, Guadalcanal, are described.

Order OPILIONES.
Suborder PALPATORES.
Division EUPNOI Hans. and Sor.
Family PHALANGIIDAE Simon.
Subfamily GAGRELLINAE Thorell.

Gagrella neocera, sp. nov.

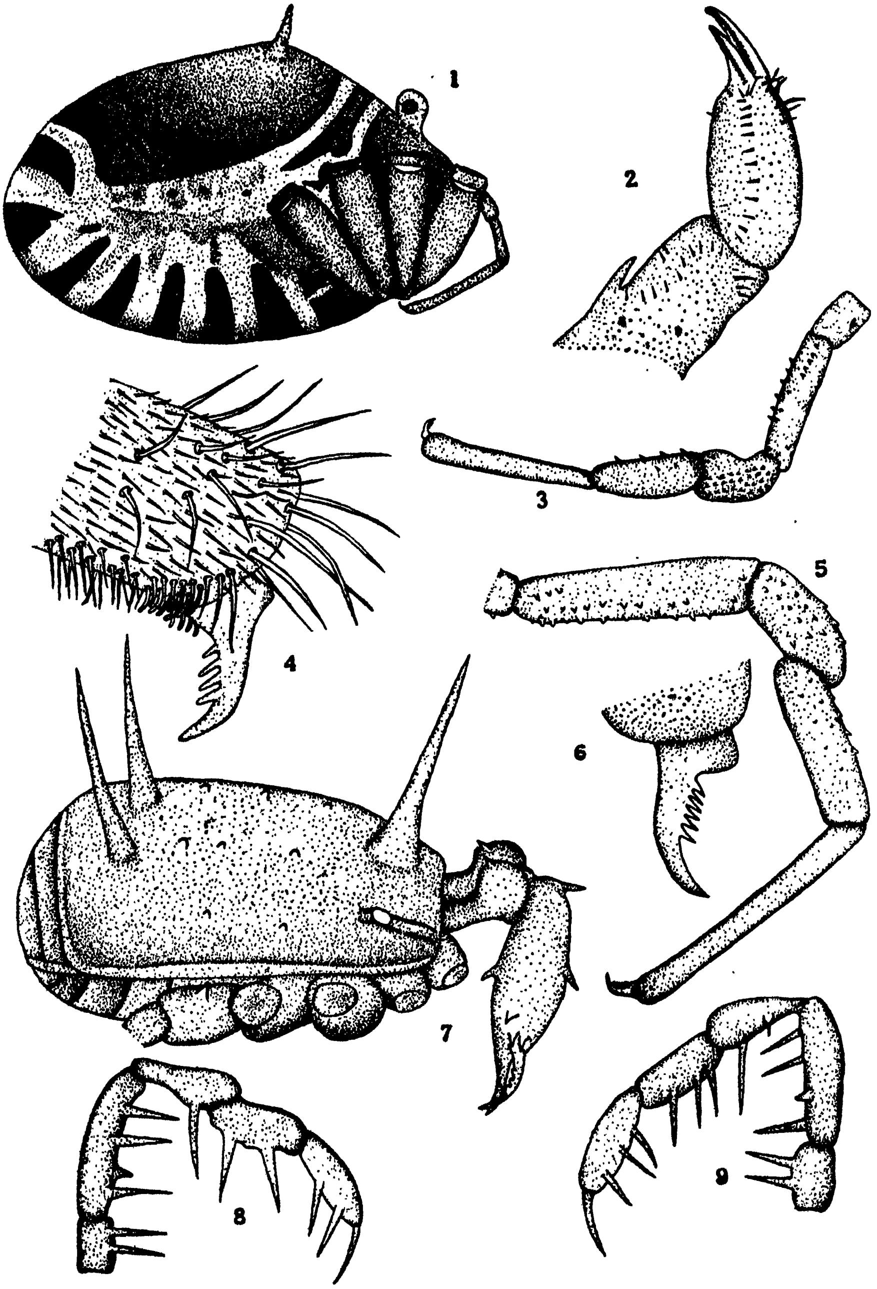
(Figs. 1–4.)

Colour.—Sclerotized areas of body, eye-mound and dorsal spine dark blackish-brown. Surface between sclerotic areas, pedipalps and chelicerae, yellowish-brown. Coxae blackish-brown.

Body.—Sclerotized areas finely granulate Eye-mound rising from the middle of a strongly sclerotized cephalo-thoracic plate and directed slightly back, smooth, with a median longitudinal groove, along each side of which is a line of small pale setae. Second cephalo-thoracic plate narrow and extending below the scutum formed by the fusion of the first five tergal plates (fig 1). Scutum without transverse grooves and with a strong, forwardly-directed spine at one-third. The three free tergites distinguished by transverse plates, but the anterior plate connected with the scutum in some specimens by a thickening of the intermediate integument.

Sternites represented by five transverse plates, a small triangular plate at each basal corner, and a further slender plate at each side of the genital operculum. Genital operculum as broad at the base as long, but narrowing distally Lateral margins with row of small denticulations.

Pedipalpi.—Without apophysis. Femur below with a number of small peg-like denticulations, and a further proximal inner row of five; patella closely covered dorsally, and tibia with a proximal inner row of three and a ventral row of four similar denticulations. Tarsus smooth (fig. 3). All segments clothed with numerous short setae, rising directly from the surface of the integument and a smaller number of long setae rising from pits. Disto-ventral surface of tarsus with a number of comparatively stout pitted setae which, near the base of the claw, are modified into strong blunt rods with recurved tips. Tarsal claw with a ventral row of four strong teeth (fig. 4).

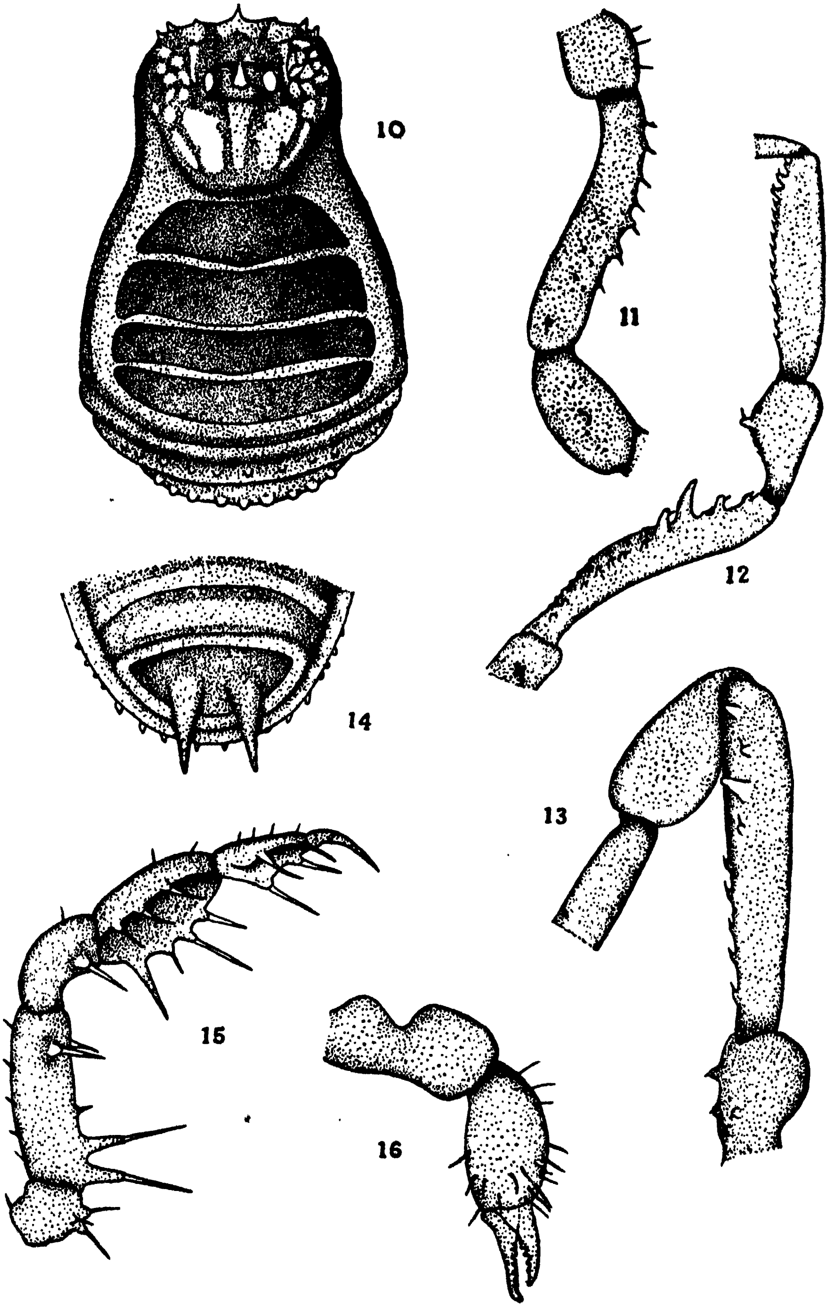


Figs. 1-4.—*Gagrella neocera*, sp. nov.—1, Lateral view of body. 2, Outer view of chelicera. 3, Inner view of left pedipalp. 4, Distal portion of tarsus of pedipalp showing rod-like setae and teeth on tarsal claw.

Figs. 5-6.—*Gagrella aura* (Rainbow).—5, Inner view of left pedipalp. 6, Tarsal claw of pedipalp showing teeth.

Figs. 7-9.—*Ibalonius rainbowi*, sp. nov.—7, Dorso-lateral view of body and chelicerae. 8, Outer view of pedipalp. 9, Inner view of pedipalp.

Note: In figures 3, 5, 6, 8 and 9 the setae are omitted.



Figs. 10-16.—*Savoa bonka*, sp. nov.—10, Dorsal view of body of female. 11, Trochanter, femur and patella of leg III of male. 12, Femur, patella and tibia of leg IV of male. 13, Trochanter, femur and patella of leg IV of female. 14, Postero-ventral view of male, showing pair of spines on anal plate. 15, Ventro-lateral view of pedipalp of female. 16, Outer view of chelicera of female.

Chelicerae.—Basal segment with well-developed forwardly projecting basal spine. In addition to a number of scattered setae, a single row of short setae extends along the outer side of both segments from the level of the basal spine to the base of the fingers (fig. 2). Fingers short and each with a granulate ridge on the inner margin.

Legs.—Very long and slender. Coxae, trochanters and femora of legs I–IV coarsely granulate, remaining segments smooth. Margins of coxae each with a row of coarse granules.

Measurements (all measurements in millimetres).

Body: Length 4, width 2·5.

	Cox.	Troch.	Fem.	Pat.	Tib.	Met.	Tars.	Total.
Leg I	1·2	0·5	10	2	9	10	18	50·7
Leg II	1·35	0·5	20	2	19	18·7	39	100·55
Leg III	1·1	0·4	10	2	9	11	18	51·5
Leg IV	1·25	0·4	13	2	10	14	16	56·65
Pedipalp	—	0·7	2·0	0·9	1·3	—	2·3	7·2

Chelicera .... Basal 2·0, Second 2·5.

Type, Dominion Museum Collection, Tube 2/67.

Paratype, Australian Museum Collection.

Locality.—A large number of specimens were collected on low shrubs in coastal jungle, Cape Esperance, Guadalcanal. (Coll. R.R.F.)

Gagrella aura (Rainbow), 1913.

1913. *Liobunum aurum* Rainbow.

1857. *Gagrella amboinensis* Dol. (part).

(Figs. 5 and 6.)

This species was described by Rainbow (1913) under the name *Liobunum aurum*, n. sp. Roewer in "Die Weberknechte der Erde" (1923) placed the species in the genus *Gagrella* as a synonym of *G. amboinensis* Dol. While the species certainly belongs in *Gagrella*, it is undoubtedly a true species. It can be distinguished from *G. amboinensis* by the numerous denticulations on the ventral surface of the femur of the pedipalp in addition to those on the dorsal surface of the patella and tibia (fig. 5)—in *G. amboinensis* there being only two or three tiny teeth on the ventral surface of the femur. Furthermore, although the specimens are much faded, it would appear that the original colour was a yellow-brown, with the scutum a darker brown, whereas *G. amboinensis* is blackish-brown.

Type, Australian Museum, Sydney.

Locality.—Solomon Islands, precise locality not known.

Suborder LANIATORES.

Family PHALANGODIDAE.

Subfamily PHALANGODINAE.

Savoa, gen. nov.

Eye-mound wider than long, well removed from anterior margin of the cephalothorax, with a strong median spine, directed slightly forward. First five tergites fused into a carapace. Carapace smooth. Areas I–IV distinguished by four transverse plates. Free tergites 2 and 3 each with a single row of small tubercles. Sternites smooth. Spiracles exposed, clearly discernible. Genital operculum without tubercles or spines. Pedipalpi robust and strongly spined. Tarsal segments 3, 6, 5, 6, distitarsi of leg I, 2, and leg II, 3, jointed. Scopulae absent. Double claws of legs III and IV smooth and without pseudonychium. Secondary sexual characters very pronounced—femora III and

IV of male strongly curved and that of leg IV with stout spines. A pair of strong spines present on the anal plate of male.

Genotype, *S. bonka*, n. sp.

Savoa is related to both *Zalmoxis* Sorensen and *Acrozalmoxis* Roewer, but can be immediately separated from the former by the presence of a median spine on the eye-mound, and from the latter by the lack of spines on the dorsal scutum.

Savoa bonka, sp. nov.

(Figs. 10–16.)

Female.

Colour.—Cephalothorax yellow-brown with black-brown reticulate markings. Areas I–IV dark brown. Area V with median transverse black line. Remainder of carapace yellow-brown. Free tergites yellow-brown with indefinite black-brown reticulations. Anterior margin of sternites dark brown, remainder yellow-brown. Coxae light yellow, legs light brown.

Body.—As in generic description. Anterior margin of cephalothorax with seven small teeth, one median, two at each corner and a further small one at midway on each side (fig. 10). Free tergites 2 and 3 each with a single transverse row of low seta-tipped tubercles. Anal plate with a number of similar tubercles. Genital operculum smooth—sternum slender, tapering anteriorly.

Pedipalpi.—Trochanter below with three spinous tubercles, the median being smallest. Femur proximally below with two large spinous tubercles in line, followed by a small spined tubercle; at five-sixths are two further lateral spined tubercles. Patella distally, with a single large inner spinous tubercle. Tibia concave below and armed on the outer margin with a line of one large, one small and a further two large spines, and on the inner margin with a line of three uniform large spines. Tarsus concave below, armed with two outer and two inner strong spines.

Chelicerae.—Smooth, without spines or tubercles. Basal segment constricted at half-way, but swollen on the distal dorsal surface of the segment. Second segment when measured to the base of fingers, little more than one and a half times as long as wide. Fingers evenly toothed. Movable finger longer than fixed (fig. 16).

Legs.—All segments straight, not curved. Femur I with a ventral row of six small spinous tubercles. Remaining segments of leg I and legs II and III smooth, without spines or tubercles. Trochanter of leg IV below with a number of small tubercles on the proximal surface and a single large tubercle on the distal surface. Femur with a ventral row of five small tubercles, which extend to approximately half-way, and a further distal row on the prolateral surface of four tubercles, the second and fourth being relatively large (fig. 13). All tubercles on legs with a single sub-apical seta. Coxae I and II and ventro-lateral margins of coxa IV with numerous small setose papillae.

Measurements.

Body: Length 2·5, width 1·5.

	Cox.	Troch.	Fem.	Pat.	Tib.	Met.	Tars.	Total.
Leg I	0·3	0·25	0·6	0·3	0·5	0·7	0·55	3·2
Leg II	0·32	0·35	1·0	0·5	0·85	1·0	1·0	5·02
Leg III	0·34	0·25	0·8	0·3	0·7	0·9	0·65	3·94
Leg IV	0·56	0·5	1·2	0·6	1·0	1·25	0·75	5·86
Pedipalp	—	0·4	0·6	0·3	0·5	—	0·35	2·15

Chelicera: Basal 0·6, Second 0·65 .... 1·25

Male.

Colour as in female.

Body larger and more deeply constricted between cephalothoracic and tergal region than female. Anal plate with a transverse pair of strong spines (fig. 14).

Legs.—Femora III and IV strongly curved. Femur of leg I with single ventral row of five small setose tubercles. Leg II smooth. Femur of leg III with ventral row of seven setose tubercles (fig. 11). Leg IV strong, proximal ventral surface of femur with numerous small setose papillae, distal ventral surface with a row of five blunt spines, the second, largest and non-setose. Patella below with a large median-placed blunt setose spine, preceded by a number of small setose papillae. Tibia with single ventral row of fourteen spinous tubercles. Metatarsus with a ventral row of very small spinous papillae. Calcaneus absent (fig. 12).

Chelicerae and pedipalpi as in female.

Measurements.

Body: Length 2·75, width 2·0.

	Cox.	Troch.	Fem.	Pat.	Tib.	Met.	Tars.	Total.
Leg I	0·35	0·25	0·75	0·45	0·5	0·9	0·6	3·8
Leg II	0·36	0·3	1·2	0·6	1·0	1·25	1·2	5·91
Leg III	0·40	0·3	0·85	0·45	0·75	1·05	0·65	4·45
Leg IV	0·6	0·6	1·9	0·85	1·55	1·5	0·75	7·75
Pedipalp	—	0·25	0·65	0·35	0·5	—	0·4	2·15
Chelicera: Basal 0·65, Second 0·75								1·40

Co-types (male and female), Dominion Museum Collection, Tube 2/69. *Paratypes*, Australian Museum Collection; Dominion Museum Collection, Tube 2/70.

Locality.—Large numbers of both males and females were collected under dead branches and coconut fronds in coastal forest, Savo Island.

Subfamily IBALONIINAE Roewer.

Ibalonius rainbowi, sp. nov.

(Figs. 7–9.)

Colour.—The specimens have been preserved in spirit for many years and are now of a uniform light yellow.

Body.—Symmetrically oval. Cephalothorax and tergites I–V fused into a scutum. Transverse grooves not visible, but position of tergites, I, II and III each distinguished by a single transverse row of granules. Tergite IV with a median pair of erect smooth spines, slightly higher than depth of body. Eye-mound absent, eyes lateral, each placed on small longitudinal ridge. Between the eyes rises a large median erect spine as high as depth of body (fig. 7). Free tergites smooth. Sternites each with a single transverse row of small granules.

Pedipalpi.—Slender, coxa unarmed; trochanter with two ventral spines; femur with ventral row of four spines, the second being small and blunt. Patella distally with one outer and one inner spine and a further small spinous tubercle on the proximal half of the inner surface. Tibia and tarsus each with two outer and three inner spines. Tarsal claw slender, almost as long as tarsus (figs. 8 and 9).

Chelicerae.—Basal segment constricted proximally, both segments spined as in fig. 7. Movable finger strongly curved, crossing fixed finger near tip.

Legs.—Coxa I armed with numerous spinous papillae. Coxae II, III and IV coarsely granulate. Coxa IV with a strong dorsal spine. All legs smooth, without spines or tubercles. Tarsal segments 4, 12, 5, 5. Distitarsus of leg I two-jointed, of leg II four-jointed. Tarsi III and IV with smooth double claws and a thick basal scopula.

Measurements.

Body: Length 2·9, width 2·4.

	Cox.	Troch.	Fem.	Pat.	Tib.	Met.	Tars.	Total.
Leg I	0·38	0·3	2·0	0·41	1·75	2·2	0·92	7·96
Leg II	0·38	0·41	9·24	0·96	9·2	18·4	2·4	40·99
Leg III	0·38	0·4	6·29	0·92	3·59	5·92	1·11	18·61
Leg IV	1·11	0·55	9·09	0·94	4·92	7·7	0·98	25·29
Pedipalp	0·37	0·38	0·8	0·78	0·75	—	0·78	3·86

Chelicera: Basal 0·74, Second 1·52 .... 2·26

Cotypes.—Two specimens in the collection of the Australian Museum, Sydney, have been designated cotypes. Owing to the time the specimens have been preserved in spirit, it is not possible to determine the sex of the specimens accurately.

Locality.—Russell Island. Coll. W. Froggatt.

Selected Bibliography.

Rainbow, W. J., 1913.—*Rec. Aust. Mus.*, vol. x, No. 1, pp. 1-3.
Roewer, C. F., 1923.—*Die Weberknechte der Erde.* Jena.

A NEW PIPEFISH FROM QUEENSLAND.

By A. FRASER-BRUNNER, F.Z.S.,
British Museum (Natural History),

and

G. P. WHITLEY, F.R.Z.S.,
Curator of Fishes, Australian Museum.

(Figures 1–2.)

When drawing some types of Australian fishes in the British Museum, the senior author found a specimen of a Queensland Pipefish which did not agree with Günther's type (from Suez) of the species (*Acentronura tentaculata*) with which it had been previously associated (Duncker, 1915; McCulloch and Whitley, 1925; Dollfus and Petit, 1938). He prepared a description and figure of the specimen, and sent them to the junior author, who studied the fish in relation to the literature and made taxonomic comparisons with its congeners. The specimen is considered to belong to a new species.

Family SYNGNATHIDAE.

Genus ACENTRONURA Kaup, 1853.

Acentronura breviperula, sp. nov.

(Figure 1.)

Length of head contained 2½ times in head plus trunk. Snout equal to diameter of eye, half as long as postorbital part of head. Tail about 1⅓ times length of combined head and trunk. Thirteen body rings; 42 tail rings, the first seven of which form the brood-pouch. Dorsal fin on 4½ rings, two of which are caudal. Dorsal rays 16; pectoral 15. Dermal filaments as shown in figure 1; larger filaments generally on each fourth ring. General characters of the genus as defined by the authors quoted in the list of references below, and as figured.

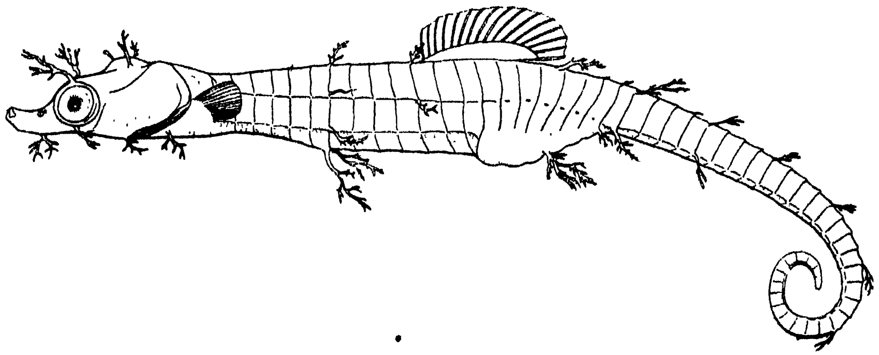


Figure 1.—*Acentronura breviperula* Fraser-Brunner and Whitley.
Holotype from Mabuiag, Torres Strait, Queensland.
A. Fraser-Brunner, del.

Described and figured from the holotype, a specimen about 35 mm. long, from Mabuiag, Torres Strait, Queensland; coll. A. C. Haddon. British Museum registered no. 90.1.14.51.

The male specimen upon which this new species is founded differs from others of its genus in the short brood-pouch, which is borne on only seven rings, and in the proportions of the head, the length of combined snout and eye being equal to the postorbital length. In all other species the postorbital part of the head is relatively shorter.

The genotype of *Acentronura* is *Hippocampus gracilissimus* Temminck and Schlegel, 1850, from Japan; the name was spelt *H. gracillimus* on plate cxx, fig. 6 (not 7 as stated in the text), and the latter mis-spelling has been used by later authors. The description given by Temminck and Schlegel is inadequate, and the figure shows a female example, so that no information as to the number of brood-rings can be adduced; but according to the drawing the snout was comparatively long, the trunk-rings 12 and the caudal rings more than 40, the tail being considerably longer than the combined head and trunk. Jordan and Snyder, who had a specimen from Japan which presumably belonged to the same species, counted 13 trunk-rings and 45 caudal rings, the first 13 of which bore the brood pouch; the tail was 1½ times the length of combined head and trunk.

Atelurus germani Duméril, 1870, from Cochin-China, has been regarded as a synonym of *A. gracilissima;* the snout is slightly longer than the eye and equal to the postorbital length, and the brood-rings number eleven. Under the name *Acentronura gracillima*, Day described two specimens from the Andaman Islands, but it is possible that, in fact, these belonged to our new species, *A. breviperula.* The figure shows the brood-pouch on only 7 or 8 rings and the tail comparatively short.

In *A. tentaculata* Günther 1870, from Suez, the first 12 caudal rings form the brood pouch; snout and eye together are much longer than postorbital part of head; the tail is about 1½ times head and trunk combined. The dorsal fin is on 4½ rings, the last three of which are caudal. Dermal filaments are much longer and more numerous, the principal ones on each second or third ring. Type examined and figured here for the first time (Figure 2). Günther's holotype, 45 mm. long, was obtained in the Gulf of Suez and presented by R. MacAndrew to the British Museum, where it is registered no. 1869.6.21.8.

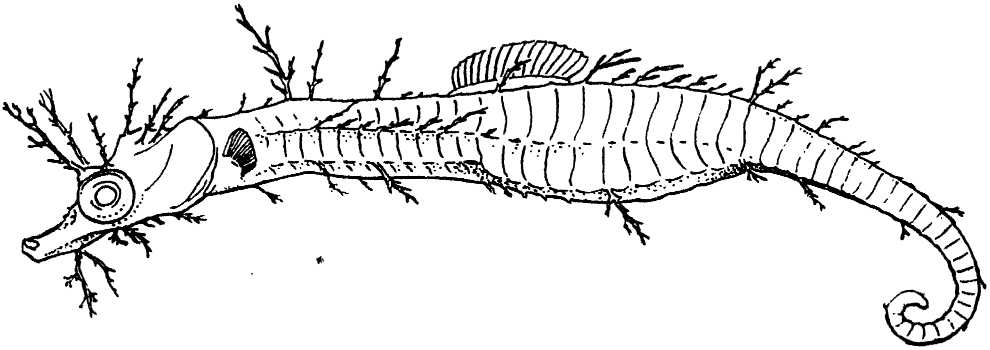


Figure 2.—*Acentronura tentaoulata* Günther. Holotype from Suez.
A. Fraser-Brunner, del.

Acentronura australe Waite and Hale 1921, from South Australia (see also Waite 1921 and 1923), has 12 brood-rings and the tail 1·4 times the length of combined head and trunk, but the postorbital part of the head is very little shorter than the rest. Whitley (1947)) has proposed a distinct genus *Idiotropiscis* for this species, on the ground that the tail-rings number only 38 and that the upper body-ridges are not continuous with those of the tail. The tail-rings number 41 to 45 in other species,

and counts in this region are very uncertain since the last few are indistinct, so that the value of this character is doubtful. Since in the other species the upper ridges are continuous, however, the southern form may well represent a sub-genus.

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WAISTED HAMMERSTONES FROM THE MACKAY DISTRICT, QUEENSLAND.

By **Frederick D. McCarthy**, Dip.Anthr. (Syd.).
Curator of Anthropology, The Australian Museum.

(Plate vii.)

Waisted hammerstones and pounders are rare in Australia, and the excellent series of twenty-five specimens herein described constitutes the only large group collected in one locality in the whole of the continent. They were kindly submitted to me for description by Mr. J. H. Williams, of Mackay, who collected most of them. The first two examples were ploughed up on Mr. P. Furlong's farm at Mt. Jukes, one being found by Mr. Furlong and the other by Mr. B. Woodyard. The series is numbered 3 to 8, 12, 14 to 30, and E.52062, of which Nos. 16–17, 23, and 52062 are now in the Australian Museum and the balance in the Mackay Museum. Nos. 1–2, 9 to 11, and 13 are not hammerstones.

Mt. Jukes, a volcanic neck sixteen miles (25·75 kilom.) east of the main range, is almost surrounded by a crescentic and hilly valley with fertile flats along the creeks. In this valley Nos. 23 to 24 and E.52062 were found. Sir Alec Macartney, whose father owned the original grazing property and farm in the valley, informed Mr. Williams that the area was a favourite hunting ground of the Mackay aborigines whose territory extended southward to St. Lawrence. The valley has three outlets. One is Jordan's Gap, where Nos. 6 to 8, 16–22, and 29 were found; it is a col with a scrub-covered spur on one side and an open-forest covered spur on the other side and the hammerstones were collected on an oval-shaped camp-site about eighty feet (24 metres) long which extends into the Gap. The second outlet is Tecon's Gap, where No. 26 was found, about half a mile (804 metres) to the west. The third outlet is a gorge through which Milson's Creek flows, about one mile (1·609 kilom.) south of Jordan's Gap, which yielded No. 27. Mr. Williams made a thorough search of these outlets because he thought that natives travelling through them might have left implements in such situations for intermittent use.

Nos. 12, 14 to 15, and 25 were collected along Devereaux Creek, near the base of Mt. de Moleyns, eight miles (12·87 kilom.) south-south-west of Mt. Jukes, on the northern arm of the coastal plain; some of these were found by Mr. G. Gaudry. Nos. 3 to 5 came from Seaview, the only coastal site, eight miles (12·87 kilom.) north-west of Mackay and thirteen miles (20·92 kilom.) east of Mt. Jukes. They were ploughed up by Mr. J. A. Edwards on his farm. There is an old camp-site at Seaview in the dunes fringing the beach, on which there are large numbers of water-worn pebbles and lumps of stone.

Description.—The twenty-five specimens are described in five groups to show their range of type and method of workmanship.

1. *Trimmed Blanks.*

Three examples, No. 4 (Pl. vii, fig. 1) from Seaview, and Nos. 16 and 18 from Jordan's Gap, are rectangular flat blocks of grey porphyry, grey and pink granite, with cortex surfaces on their straight sides and ends. One set of flake-scars is present along the top and bottom edges of the lateral margins on both surfaces, but these margins show no signs of percussion use. They are 16 × 11 × 5, 21 × 11 × 4·5, and 21 × 15 × 4·5 cm. in size, and 3, 4½ and 5⅞ lb. in weight. Two large spalls have broken off the ends of No. 16 and it is probably a reject.

2. *Waisted Blanks.*

The eleven examples comprise Nos. 6, 8, 17, 19, 20 (Pl. vii, fig. 3), 22, and 29 (Pl. vii, fig. 2) from Jordan's Gap, No. 3 (Pl. vii, fig. 5) from Seaview, No. 12 from Devereaux Creek, No. 26 from Tecon's Gap, and No. 27 from Milson's Creek gorge. They include four rectangular blocks of grey porphyry, grey tuff and pink granite with straight ends and flat sides, two pebbles of brown porphyry with convex ends, one pebble of grey porphyry, and two lumps of indurated shale or tuff. They are from 12 × 9 × 4 to 21 × 14 × 6 cm. in size, and 1¾, 2, 2½, 3, 3⅛, 3¼ (2), 3½, 5¼, 5½, and 5⅞ lb. in weight. Nos. 8 and 26 have a battered concave edge on one lateral margin, each about 7 × 1 cm. No. 22 is triangular in transverse section, with a flat cortex back, sides and ends, and a battered concave 5 cm. long and 1 cm. deep in the middle of the thin margin. Nos. 17, 19, 20 and 29 have a battered concave, from 5 × 1 to 9 × 1 cm. in size, in the middle of both lateral margins. No. 27 has a flaked concave on each lateral margin, and a line of flake-scars along one surface at one end. No. 12 is an elongate flat pebble wider at one end than the other, flaked and battered along both shallow concave lateral margins. Nos. 19, 20 and 29 are also pebbles with rounded unused ends. The largest specimen in this group, No. 3, is very thick, has one flat cortex surface upon which something has been rubbed to produce a narrow and shallow groove 1·5 cm. wide; the other surface is crudely flaked to a convex shape, so that the specimen is plano-convex in transverse section. Its two concaves are 8 × 1 and 9 × 1 cm. A line of small flake-scars, due to flakes being knapped from the end, is present along the edge of one surface on some of these specimens.

3. *Waisted hammers with straight butt.*

Three examples, No. 7 from Jordan's Gap, No. 14 from Devereaux Creek, and E.52062 (Pl. vii, fig. 9) from Mt. Jukes. They are made of grey granite, pink granite and fine-grained black breccia, are from 15·5 × 11 × 4 to 16 × 10·5 × 4·75 cm. in size, with the greatest thickness 6 cm., and 2½ to 3 lb. in weight. Each possesses a concave, ranging from 5 × 1 to 9 × 1 cm. in the middle of both lateral margins. The butt is a straight flat cleavage or cortex surface. The bevelled edges are battered from end to end along the lateral margins and round the convex distal end of each specimen. These three are fine examples, uniform in type, and varying little in size and weight.

4. *Waisted hammers with two convex ends.*

Four examples of the most developed type in the whole series, comprising Nos. 23 and 24 (Pl. vii, fig. 6) from Mt. Jukes and Nos. 15 (Pl. vii, fig. 10) and 25 (Pl. vii, fig. 4) from Devereaux Creek. One is made of breccia, one of grey porphyry, one of a fine-grained igneous rock like andesite, and one of brown grit. They are all long specimens, ranging from 18 × 16 × 9 to 24 × 16 × 6 cm. in size, although one is only 3·5 cm. thick, and are 4 (two), 5¾, and 6¾ lb. in weight. Each specimen possesses a concave in the middle of both lateral margins, ranging from 5 × 1·5 to 8 × 2 cm. Nos. 23 and 25 are thicker at one end than the other. No. 23, the largest specimen, has a straight thick end crudely flaked to a convex shape, and the other end consists of two oblique edges terminating in a rounded point which is battered by use. Nos. 24 and 25 are flaked to a convex shape on both ends, and on the former this battering is continued right around its lateral and end margins; it is limited to both ends on No. 25. No. 15, the thickest example, is only slightly battered on parts of its ends, and apart from the removal of a few flakes on one surface at one end, its ends are both unshaped.

5. *Hammer with encircling groove.*

No. 30 (Pl. vii, fig. 7) from Devereaux Creek District, near base of Mt. de Moleyns, is made of brown sandstone, and one end is missing. The butt and lateral margins are flaked from both surfaces to form a bevelled edge, which is battered along its entire extent. The groove has been made by pecking. It is 14 × 11 × 4 cm. in size and 1¾ lb. in weight.

A lenticular blade of grey granite (Pl. vii, fig. 8), 10 × 10 × 3 cm. in size, with straight lateral margins, a flat weathered fracture face as its butt end, and a battered distal end, and two other broken specimens cannot be placed in the above groups.

Characteristics.—These hammerstones possess certain definite characters. The concaves forming the waist, and the lateral and end margins where trimmed, bear a bevelled edge shaped by the knapping of flakes from the upper and lower surfaces. This edge, both in the concaves and elsewhere, was then battered, and this percussive use constituted the main function of the implements. Additional trimming on some specimens in groups 2 to 4 consists of the removal of a line of small flakes along one or both edges of the straight butt and struck from the end down the upper and lower surfaces. The trimming and use have not altered the fundamental shape of the natural lumps or pebbles utilized. Their transverse sections include the rectangular, trapezoid, lenticular and plano-convex forms, which is natural on some specimens and fashioned on others. The range of materials includes soft grits and sandstones, fine-grained hard and tough breccias, tuffs and breccias, and coarse granites, a fact which indicates that the material was not as important as weight in their use.

Uses.—There is no record of the function of these implements in the Mackay district, but they appear to belong to a group of large pounders used for various purposes in the heavily forested country of the Queensland coast. Roth (1904, Sect. 37, figs. 151–54) recorded the use of hafted pebble hammers for loosening sheets of bark by tapping along trenched outlines on the tree, for pounding pandanus and other nuts, and for knapping stone implements, in the Palmer River and the Princess Charlotte Bay areas of Cape York. He also recorded (op. cit. Sect. 38, figs. 160–3, 165) ironwood mallets, up to 7 lb. in weight, used in Cape York for pounding vegetable fibre, nuts and foodstuffs. Thomson (1936, pp. 71–73, Pl. viii) said that rounded quartz and diabase pounding stones are used in Cape York by the Koko'Taiyuri tribe on Edward River, especially for pounding the hard desiccated fruit of the Nonda palm (*Parinarium nonda*). These hammerstones are not worked or shaped in any way, but constant and prolonged use produces a flattened or slightly concave end on them. They are hafted in a withe handle. The ironwood mallets and anvils, on the other hand, he said, are used for pounding most of the other vegetable foods. These stone hammers are much smaller than the waisted type from Mackay.

It is probable that the Mackay waisted hammerstones were hafted on a withe handle and were used for loosening bark sheets, knapping stone implements, pounding nuts and the crude bark-cloth made on the Queensland coast. The battered distal ends on the specimens described vary from a very narrow to a broad flat face, the latter no doubt the result of long usage.

Affinities.—It will be noticed that the ironwood mallets figured by Roth are grooved all round the head as a result of use, but the battering on the concave indentations of the Mackay waisted hammerstones is probably part of the process of fashioning them.

The lenticular edges and transverse section on Nos. 12, 14, 24 to 25, 28 and E.52062 of the Mackay hammerstones resembles technically the broad lenticular blade of the *Yodda* tanged implements (McCarthy, Bramell and Noone, 1946, p. 77, fig. 382), a point which may or may not indicate a similar function for the two types; the *Yodda* implements, however, are completely pecked and some are polished all over their

surfaces, thus representing a much more advanced type technically than the Mackay hammerstones, among which No. 30 is the only one bearing pecking which is limited to its encircling groove.

The most definite comparison that can be made is between the Mackay hammerstones and a series of large hammers from a quarry on Daruka Station, Moor Creek, Tamworth district, New South Wales (McCarthy, 1941). Most of the hammers from this quarry are rectangular and trapezoidal blocks of basalt from 10 to 17 cm. long and from 1¾ to 3 lb. in weight. They too are flaked along both edges of the lateral margins in the same manner as the Mackay hammerstones. One of them (op. cit., Pl. iv, fig. 5) is waisted, and identical in shape and size with No. 14 of the Mackay series, others are like No. 22, and some, particularly Pl. iv, fig. 2, which is 35 x 10 x 7 cm. in size and 8 lb. in weight, are similar to group 2 from Mackay.

We can conclude, therefore, that these heavy hammers form a type limited in distribution at present to eastern Queensland and north-eastern New South Wales. Archaeologically, there is as yet no evidence to indicate their age. Mr. Williams, from his field observations, believes that they were used in the Mackay district prior to the introduction of the ground-edge axe.

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EXPLANATION OF PLATE VII.

Fig. 1.—Trimmed blank, No. 4 of group 1, of grey porphyry, rectangular section. Seaview.

Fig. 2.—Waisted blank, No. 29, of group 2, of grey porphyry, flattened oval section. Devereaux Creek.

Fig. 3.—Waisted blank, No. 20 of group 2, of grey granite, lenticular section. Seaview.

Fig. 4.—Waisted hammerstone, No. 25 of group 4, of grey tuff, rectangular section, battered along all margins. Devereaux Creek.

Fig. 5.—Waisted blank, No. 3 of group 2, of grey tuff, planoconvex section. Seaview.

Fig. 6.—Waisted hammerstone, No. 24 of group 4, of grey porphyry, lenticular section, lightly battered on various parts of its margins. Mt. Jukes.

Fig. 7.—Grooved hammerstone, No. 30, of group 5, of brown sandstone, lenticular section.

Fig. 8.—Lenticular blade of grey granite.

Fig. 9.—Waisted hammerstone, E.52062 of group 3, of black breccia, lenticular section, battered along both lateral margins and distal convex end. Mt. Jukes.

Fig. 10.—Waisted hammerstone, No. 15 of group 4, of brown sandstone, lenticular section. Devereaux Creek.

Photographs by Howard Hughes.

SOME PREHISTORIC AND RECENT STONE IMPLEMENTS FROM NEW GUINEA.

By FREDERICK D. MCCARTHY, Dip.Anthr. (Syd.).
Curator of Anthropology, The Australian Museum.

(Plates viii-xi.)

The implements herein described consist of an interesting collection of prehistoric specimens which includes a number of new types, and a series of implements, also hitherto undescribed types, used by modern natives. All of these pieces are in the collection of the Australian Museum, to whom they were presented by various donors, as stated. To eliminate repetition of the somewhat lengthy localities the following details refer to the majority of the specimens, and the localities are given with those not included below:

Nos. 1–11 (mortars), 14–16 (pestles), 23 (animal figure), 26–29, 32, 40–42 (club-heads) are prehistoric pieces which were unearthed in native gardens in the Iani-Halumgali portion of the southern Wahgi valley. The local natives know nothing about the true origin of these implements and call them *kobiloa* or stones; they believe that they were made by spirits or supernatural agencies, and always wrap them in banana leaves to prevent the women and children seeing them. They were collected and presented by Mr. A. L. Costelloe, District-Officer at Chimbu.

Nos. 13 (mortar), 21–22 (animal figures) are prehistoric pieces found about ten years ago by natives up to a depth of eighty feet in hillsides, after landslides, between Bena Bena and Mt. Hagen. The natives said that these pieces were made by the spirits. They were given to a German named Aufenanger, who was interned, and were subsequently forwarded to the Museum by Mr. Costelloe.

Nos. 24 (abrading stone), 25, 30, 33, 36, 39 (club-heads) were found in native gardens between Bena Bena and Mt. Hagen. They were not used by the local natives, who regarded them simply as stones. Mr. Costelloe has informed me that similar types of club-heads are in use along the Tauri River and could have reached the Wahgi valley by trade, so that it is uncertain whether this series is prehistoric. This series was also in the possession of Aufenanger and was forwarded to the Museum by Mr. Costelloe.

Nos. 31 and 34 (club-heads) are from the Iani-Halumgali portion of the southern Wahgi valley. They were collected and presented by Captain N. B. Blood.

Nos. 35 and 37 (club-heads) were collected in the Mt. Hagen district, Wahgi valley, by Mr. J. L. Taylor, District-Officer, and both are prehistoric pieces found in native gardens.

A. MORTARS.

1.—E.52454. Circular, grey sandstone with weathered pecked surface, irregular convex base, and eleven convex bosses on the outside. It is 25 cm. in diameter, 10 cm. thick, and has a small hollowed basin 12 cm. in diameter and 4 cm. deep.

2.—E.52455. Oval, grey andesite, pecked surface, well shaped, with ridged lip cracked in seven places, and with eight convex bosses; it is 22 × 20 cm., 11·6 cm. thick, and has a large basin 13·5 × 14 cm. and 4·5 cm. deep, used in modern times for pounding and mixing a pink ochre.

3 to 8.—This series consists of six small, high mortars, each standing on a flanged base:

3.—E.52449 (Plate xi, fig. 26). Oval, grey andesite, weathered surface, rounded lip, and a rounded ridge just above the base; it is 13 cm. high, 12·5 × 11·5 cm. at the top, with a basin 5 cm. deep and a base 10 × 8·5 cm.

4.—E.52450. Circular, sandstone, very weathered surface, ridged lip, a row of very small elongate bosses discernible on one side only and the remainder weathered away, and an irregular circular base 10 cm. in diameter. It is 11·5 cm. high, 14 cm. in diameter at the top, with a basin 6·5 cm. deep.

5.—E.52451 (Plate xi, fig. 28). The finest and best preserved example in the series. The top is oval but wider at one end than the other; it is made of grey andesite, and has a ridged lip, a row of small rectangular and convex bosses separated from the lip by a groove, from which the outside surface slopes diagonally to the flat flanged base 12 cm. in diameter. Its general shape is asymmetrical and the surface is polished over the pecking. It is 13 cm. high, 20 × 18 cm. at the top, with a basin 16·5 × 15 cm. and 6 cm. deep. Right around the inside of the basin is a branching line pattern (like a plant), incised in fine lines. The end of each stem terminates in a circular groove.

6.—E.52452. Circular, very weathered pecked surface the yellowish colour of which appears to be due to the deposit in which it lay for a long period. It has a row of medium-sized horn-like bosses all but one of which are broken and worn away, and below them the outside surface is flat, deeply concave, and then slightly convex where it joins the flat base which is 12·5 cm. in diameter. It is 10·5 cm. high, 19 cm. in diameter, with a basin 12 cm. in diameter and 5 cm. deep.

7.—E.52453. Semi-circular, being half of the specimen only, with pecked surface, a ridged lip separated by a groove from a row of rectangular, flat-topped bosses, convex outside, flat pecked area on the bottom 9 cm. in diameter. It is 8 cm. high and 13·5 cm. in diameter.

8.—E.52493 (Plate xi, fig. 27). The smallest example in the series, neatly shaped, oval, and the lip bears unevenly spaced cuts and flake-scars; on the outside is a groove 3 cm. below the lip, then a flat surface defined on its lower edge by a row of small rectangular flat and convex bosses of varying sizes, beneath which is a concave surface which joins the oval base 7 × 6 cm. There are three flake-scars on the edge of the base. It is 6·5 cm. high, 9·8 × 8·8 cm. on the top, with a basin 6·5 × 5·5 cm. and 4 cm. deep. It is a dark-brown sandstone.

9.—E.52457 (Plate viii, fig. 2). A unique specimen bearing a carved head at one end. It is oval in shape, with a polished surface previously pecked. The thin flat-topped lip, cracked in several places, is separated by a groove from a row of rectangular and convex bosses 2 × 1·5 cm., and the outside surface is convex. On the corner of one end is a carved head, 7 cm. high, 6 cm. wide, projecting 5 cm. The mortar is 9 cm. high, 23 × 18 cm. on the top, with a basin 16 × 14·5 cm., and 4·5 cm. deep. The carved head has a flat triangular surface on the back, from which a ridged beak curves outward and then inward to the middle of the mouth; each side of the mouth is a pointed oval depression extending at an angle of forty-five degrees from the flat lip for 3 cm. There is a rounded ridge along each side of the beak and a small pecked rounded boss represents each eye. All of the concave portions of this face are pecked, but the high relief portions are polished over the pecking. It is difficult to identify the creature represented; the mouth is typical of those seen on some modern wood-carvings of the human face, but the head in general form resembles a parrot or cockatoo. The mortar, as a whole, could quite well represent a tortoise. Naturalistic forms previously recorded among these mortars and pestles include birds, the possum, the lizard, a woman and a human head.

10.—E.52456 (Plate viii, fig. 3). Semi-circular half of an oval mortar, with a pecked surface, and a ridged lip separated by a groove from a row of seven and a half pointed and well-shaped horn-like bosses. The base is a flat polished surface. It is 8·3 cm. high, 23 × 10·7 cm. on the top, with a basin 13·8 × 6·5 cm. and 5·4 cm. deep. This is a very well shaped specimen.

11.—E.52457 (Plate viii, fig. 4). An oval bowl, the shallowest example in our collection, with a ridged and sharp-edged lip bearing a row of twenty-seven small triangular bosses, 28·2 cm. wide and 7 cm. thick. The basin is 24·5 cm. wide and has been worn right through by an abrading process. The slightly convex bottom is polished, and its margin is only 3·5 cm. from the periphery of the bowl. The surface is pecked elsewhere. The shape of this piece suggests that it is only about one-third of the complete bowl, and it resembles the large mill-stone type recorded by Etheridge from New Hebrides (Etheridge, *Rec. Aust. Museum*, xi, 1917, Pls. xxxii–xxxvii).

12.—E.49882 (Plate viii, fig. 1). A large irregular oval boulder of grey andesite, with a natural hollow at one end. Its surface is pecked, and it is 35 cm. long, 29 cm. wide, 20 cm. thick, with a small basin 20 cm. in diameter and 5 cm. deep. The ridged lip is separated by a groove from a row of large, low and flat bosses which narrow in width above the hollow at one end. At the other end is a human (?) face design, with large round eyes separated by a triangular flat surface on which is a vertical groove between the eyes. On each side of the latter a diagonal and curving groove runs upwards to form an encircling groove just below the lip of the mortar. On one side of the mortar the grooves around the bosses join this upper encircling groove, but on the other side are two large bosses, with a short vertical groove between them, completely encircled by their own grooves. This mortar was dredged from an alluvial layer, at a depth of between twenty and twenty-five feet, at the lower end of the Bulolo valley, and Dr. C. E. M. Gunther, who presented it to the Museum, informed me that geologists working in the valley dated the deposit at between four and five thousand years old, an age which can be correlated with that of the pecking technique in the early Neolithic period.

13.—E.52065 (Plate x, fig. 16). A circular, well-shaped mortar of small size, made of grey sandstone painted black, with a flat-lipped basin 6 cm. in diameter and 5 cm. deep. The outside surface is convex. It is 11 cm. in diameter and 7·5 cm. high. The grooved design consists of a seven-pointed star on the flat lip, with a straight line at right angles between two of the points, and on the outside surface are two rows of these points and a wavy line separated by three other grooves.

Nos. 1 to 12 possess some interesting features in common. The material is andesite in the majority, of both fine and coarse texture (in which large crystals of augite and hornblende are prominent), but sandstone and tuffs are also represented. The outside surface is convex on most mortars, but it may be straight or concave, or a combination of these shapes. The basin may be small in comparison to the dimensions of the top of the mortar, or it may occupy almost the whole area, and its surface is either pecked or rubbed smooth by an abrading process. There is usually a ridged lip separated from the row of bosses below it by a broad groove or concave surface. The bosses vary from small rectangular convex-topped shapes (like those on the knobbed club-heads) to large flat or slightly convex forms. The above characteristics form part of the technique of making these mortars, and their recognition should make it possible to establish a relationship should they be found on similar objects in south-east Asia, Indonesia, Micronesia or elsewhere in Oceania. The evidence from the Bulolo valley and the importance of the pecking technique in this culture indicate that these implements were in use from the early to the middle portions of the Neolithic period, up to about five thousand years ago.

B. PESTLES.

14 to 15.—E.52459–60 (Plate x, fig. 18). Two rounded but elongate heads of pestles, one 8·5 cm. long and 5 cm. in diameter, the other 8·5 cm. long and 7·5 × 5·5 cm. on its head. One of them bears two series of branching lines incised beside one another, on both flattened sides, and they terminate in a thin incised line which runs up two sides and across the top, whilst at the bottom they terminate in an encircling groove around the shaft. There is also a band of red ochre on the head. The top of the latter is slightly battered and it might be the pestle belonging to the mortar (No. 5, E.52451) bearing similar decoration.

16.—E.53461. A dark-brown pestle end, 6 cm. long, with a rounded shaft, broken off abruptly, 2·25 cm. in diameter, on which is a ridged band, whilst the end is a concave cup 4·75 × 4·5 cm. and 11 mm. deep. This pestle is polished on all surfaces.

17.—E.36375 (Plate ix, fig. 9). Cylindrical in shape, increasing in diameter from the butt end, which is 2 cm., to the head, which is 6·5 cm. The head is demarcated by an encircling ridge 12 cm. from the distal end, and the latter is rounded by use. The light grey surface is pecked. It is made of black basalt, and the broken surfaces show a band of weathering up to 4 mm. deep. This pestle is from Papua, being numbered 777 in the Papuan Official Collection, but the precise locality is not available. It is the longest pestle known to the writer, being 52 cm. in length.

C. BARK-CLOTH BEATERS.

18.—E.49883 (Plate ix, fig. 7). This bark-cloth beater was obtained by Dr. C. E. M. Gunther from the same deposit of alluvial gravels as the mortar No. 12, E.49882, but at the upper end of the Bulolo valley. It is black slaty stone, fine grained, flattened oval in transverse section, with a pecked and eroded surface which is slightly polished on the grip. In thickness and width it tapers from the head end, which is 5·5 × 4 cm., to the grip. It has a panel, 18 × 4 cm., of irregular sized, polished and slightly raised faces on one lateral surface of the head, formed by a series of right-angled grooves, of which there are eight transverse and thirty-five longitudinal ones; the ends of these grooves project at the sides and ends of the panel. The distal end of the head is broken abruptly. The specimen is 35 cm. long.

19.—E.18282 (Plate ix, fig. 8). A second specimen in our collection was obtained in the Huon Gulf by E. Schmidt, from whom it was purchased. It is a well-made example, being polished over a previously pecked surface, but is similar in all other respects to No. 18. The head is rounded at the end and is 5·5 × 3·5 cm., whilst the total length is 36 cm. Whether this is an archaeological specimen used by the Huon Gulf natives is not known, but the type has a wide distribution among living natives, including D'Entrecasteaux Island (Schmeltz, J. D. E., *Intern. Arch. f. Ethnol.*, I, 1888, p. 233, figure), Mafulu tribes in the Central Division of Papua (Williamson, R. W., *The Mafulu*, pp. 201–3, pl. 51, fig. 3), the Kambisa tribe in the Chirima valley, Northern Division, Papua (Monckton, C. A. W., *Ann. Rept. Brit. New Guinea*, 1905–6, figures), and elsewhere. The type is similar also to the knobbed club-heads figured by Haddon (*Jour. Roy. Anthr. Inst. Gt. Brit. Irel.*, N.S., III, 1900, Nos. 64 and 82).

20.—E.52440 (Plate x, fig. 20). A cylindrical implement, rounded at both ends, on which it is hammered to a flat face. There is a panel, 12·8 × 5 cm. on one side, enclosing fourteen longitudinal ridges, and at the ends are transverse grooves forming a series of rectangles which are not raised. The surface is pecked and weathered, and the specimen is 25 cm. long and 5·5 cm. in diameter. The Rev. Scanland, who presented it to the Australian Museum, dug it out of a prehistoric mound on San Cristoval, Solomon Islands. A similar specimen is in the collection of Mr. H. R. Balfour, of Melbourne, who obtained it from the late W. H. Gill, unfortunately without locality. It has a series of short diagonal and parallel grooves at one end of the panel of ridges. The similarity of the New Guinea and Solomon specimens indicates that both had the same function.

D. ANIMAL FIGURES.

21.—E.52063 (Plate x, fig. 15). A bird resembling a pigeon, 10 × 10 × 4 cm. It is carved in a series of planes, with a long rounded and pointed head, rounded neck, a marked concavity on the breast between the wings, and two concave wings pushed forward in front of the breast and joined in a central ridge on the back; they thus merge into three planes to form a rounded tail end. The lower surface of the body is flat, and the bird is posed on a short cylindrical post, flat on the bottom. The surface is smoothed, but pecked, and is weathered to a pale-green colour.

22.—E.52064 (Plate x, fig. 14). A small polished head in a black igneous stone, broken off abruptly at the lower end of the neck. The latter is 3 × 2 cm., lenticular in section, and merges into a long curved and rounded head, 6·5 cm. long, ending in a pointed snout. The eyes have a hollow middle and high rim. This head is not unlike that of an echidna or possum.

23.—E.52462 (Plate x, fig. 17). Made of a dark igneous stone weathered 1 cm. inwards to a yellowish colour. The rounded shaft, 5 cm. in diameter, is broken transversely, and it joins a semi-circular flange, the front edges of which project forwards like a bird's wings. In the middle of the shaft, on the opposite side, is a low rounded boss, and on top of the flange is a projection (also broken off abruptly) which was probably a bird's neck and head. The specimen is 6·5 cm. high and the flange or wings are 9 cm. wide.

E. ABRADING STONE.

24.—E.52070 (Plate x, fig. 19). An elongate pecked implement, 15 × 5 × 3 cm. The upper and lower surfaces are flattened and the ends and sides are rounded. There is a deep encircling groove 1 cm. wide and 3 cm. from one end, and a similar groove at the other end has been cut half-way around only. On the upper surface are two parallel grooves 6·5 cm. long and 8 mm. wide, straight at one end and narrowed to a point at the other end, and a third one 1·5 cm. wide on one side which joins one of the encircling grooves; these three grooves bear narrow cuts and ridges, obviously produced by a pointed object, such as a bone-point or a fire-stick. It is the only specimen of its type known to me from New Guinea.

F. CLUB-HEADS.

Ring Type.

25.—E.52067 (Plate x, fig. 20). A small circular example 6 cm. in diameter, with rounded marginal face, a wide bevel on the upper and lower surfaces extending from the hole almost to the periphery. The surface has been polished over pecking. It is very light in weight, apparently due to the weathering of the interior.

26–27.—E.52463–64 (Plate ix, fig. 11). These two large discoids are slightly irregular in shape. They are made of a grey andesite and a blackish gabbro, respectively, and their surfaces are pecked. E.52463 has one margin turned upward and the opposite flat, and it has a high ridged lip, 3 cm. in diameter, around the central perforation, which has not been made right through, although worked from both sides. E.52464 has a low ridged lip around its completed hole, 4·5 cm. in diameter. They are 22·5 × 20 × 7 and 21 × 19 × 4·5 cm., the thicknesses being measured through the lip.

Blade Type.

28–31.—Four elongate, slightly crescentic blades, with flat or slightly convex upper and lower surfaces, rounded sides concave between the hole and the flanged blade, and straight from the hole to the butt. The hole is closer to the butt than the blade, and has been hollowed by pecking through three-quarters of the thickness from one side and one-quarter from the other. The lateral margins bulge outwards on each side of the hole. The flattened butt has been used as a hammer on the three complete specimens. E.52468 is an unfinished specimen pecked all over, with unground blade, 28 cm. long, 8·5 cm. wide across the flanged blade, and 4·5 cm. thick. E.52469 is also pecked all over, is slightly larger than E.52468, and has a ground blade, a hole 4 cm. in diameter, and its butt is broken transversely to leave half of a deep oval depression on the upper and lower surfaces. E.52066 is polished all over, 16 cm. long, 5·5 cm. wide across the flanged blade, with a hole 3·5 cm. in diameter. E.52533 (Plate ix, fig. 6) is a slim and beautifully polished example, markedly crescentic in shape, 26 cm. long, 6 cm. wide across the flanged blade, and has a series of small flake-scars along the edge of its battered butt.

32.—E.52467 (Plate ix, fig. 10). A broad flat blade, light grey in colour, 17 x 10·5 x 2 cm. in size, polished on both sides, central hole 3·5 cm. in diameter, blade edge in the middle axis, butt hammered flat.

Knobbed Type.

33.—E.52068 (Plate x, fig. 22). An almost circular polished specimen, 9·5 x 8·5 x 2 cm., central hole 2·5 cm. and ridged lip 4 cm. in diameter. It is decorated on the upper surface with radiating cuts beginning at a small puncture near the lip, forming a series of rectangular and flat panels, below the ends of which is a deep encircling groove on the margin. The lower surface is smooth and flat.

34.—E.52334 (Plate x, fig. 25). A circular example, polished·over pecking, made of a blackish igneous stone, 11·5 cm. in diameter, 1·5 cm. thick, hole 2 cm. in diameter with a high ridged lip, below which, on the upper and lower surfaces, are twenty-two convex ridges of different widths separated by deep grooves; the ends of the ridges form two rows of knobs separated by a deep encircling groove on the marginal face.

35.—E.37059 (Plate x, fig. 24). A crude example 10 cm. in diameter, lenticular in transverse section, and 3·5 cm. in greatest thickness. From the single row of marginal knobs the upper and lower surfaces slope upwards to a high ridged lip around the hole 2·5 cm. in diameter. Attached to this club-head on a two-ply cord is a pyriform lump of stone, unworked, 4·5 cm. long. Both pieces have a ruddled surface.

36.—E.52067. Similar to E.37059, with only five complete knobs remaining, 8·5 cm. in diameter, hole 2 cm. with high ridged lip 1 cm. wider.

37.—E.37060 (Plate x, fig. 21). A fine example 9·5 cm. in diameter and 6 cm. thick, with two rows of conical but thick-ended knobs 2·cm. long in eight well-spaced pairs vertically arranged. The hole is 2 cm. and the high ridged lip 4·5 cm. in diameter. Some of the knobs are worn down by weathering.

38.—E.52466. Similar to No. 37, with two rows of eight knobs 5 mm. long. It is a weathered example 6 cm. in diameter, 4·8 cm. in thickness, with a hole 1·5 cm. and lip 3·5 cm. in diameter.

39.—E.52069. The two rows of knobs are arranged so that each one of the upper row of eleven lies between two of the lower row. A band of pink ochre is painted on the outside of the ridged lip.

40.—E.52465 (Plate x, fig. 23). A damaged specimen 8 cm. in diameter and 4·5 cm. thick, with two rows of rounded knobs 1·5 cm. long, the top series lying interspaced between the lower series, and some of the knobs project upwards. The hole is 1·8 cm. in diameter and the smooth lip is not ridged. It is painted pink on the outside of the hole, and there are four alternate bands of pink and white across the knobs.

Star Type.

41.—E.52471 (Plate ix, fig. 13). A three-pointed star made of coarse green gabbro. Two of the rays are broken off at the base and the other complete one is 11 cm. long. The hole is 3·5 cm. in diameter and has been hollowed obliquely, principally from one surface.

Triangular Type.

42.—E.52470 (Plate ix, fig. 12). A thick club-head, with the end slightly shorter than the two sides; the marginal faces are convex, and the hole, 4·5 cm. in diameter, has been pecked through half-way from each surface. The latter are polished over pecking. It is 16·5 × 13·5 × 6·5 cm.

G. Hafted Clubs.

The following seven club-heads are types not represented in Haddon's classification of New Guinea stone club-heads (*Jour. Roy. Anthrop. Inst. Gt. Br. Irel.*, N.S., iii, 1900, pp. 221–50, pls. xix–xxiii).

Globular Type.

43.—A.15363 (Plate xi, fig. 31). A poorly made club-head, in a green fine-grained stone, 6·5 cm. in diameter and 8 cm. thick, with a hole 2·25 cm. and lip 3·5 cm. in diameter. It is cylindrical in shape, each end being a flat lip, and in the middle is a broad convex ridge bearing one and a half flat lozenges grooved along each side, but the other two and a half are not properly formed. Its surface is polished over pecking. The handle is 120 cm. long, fitted with a narrow band of plaited cane to hold the stone head in position, and decorated with a bunch of feathers at the top. Koiari tribe, Port Moresby, Papua.

Knobbed Type.

44.—A.15343 (Plate xi, fig. 30). A dark igneous club-head with pecked surface, 8 cm. in diameter, 5 cm. thick, with a hole 2·25 cm. and lip 4·5 cm. in diameter. The lip at both ends of this cylindrical shaped piece has a row of eight rounded knobs, oval in shape, and there is a central row of seven pairs of oval knobs. The handle is 67 cm. long, and the stone head is simply jammed downwards to hold it securely. Koiari tribe, Port Moresby, Papua.

45.—E.44036 (Plate xi, fig. 35). A most unusual example made of a brown fine-grained stone, 12 cm. long, 9·5 cm. wide and 7 cm. thick, with a hole 2 cm. and lip (without ridge) 3·8 cm. in diameter. At the end of each side is an oval sharp-edged bifurcated knob separated by a convex bifurcated ridge in the middle, arranged so that it is symmetrical when viewed from any angle. It is pecked in the grooved surfaces and polished over the pecking on the flat and projecting faces. The handle is 120 cm. long, and the stone head is held in position by a ridge on the handle. Collected by Stewart Campbell at Sinum, Upper Fly River, Papua.

46.—E.27781 (Plate xi, fig. 32). A polished dark igneous club-head 10 cm. in diameter, 5 cm. thick, with a hole 2·25 cm. and lip (without ridge) 3 cm. in diameter. It has two rows of convex projections bifurcated in the middle to produce two rows of knobs. Pieces are broken off inside many of the bifurcations as a result of use. The handle is 67 cm. long and the stone head is held in position by the cone-shaped end of the shaft. Collected at the entrance to Lake Murray, Fly River, by A. R. McCulloch and Captain F. Hurley.

47.—E.27429 (Plate xi, fig. 29). A pecked grey andesite club-head 13 cm. in diameter and 3 cm. thick, with a hole 3 cm. and lip (without ridge) 4 cm. in diameter. It has on its upper and lower surfaces twenty-nine radiating ridges, each ending in a pointed knob, in vertical pairs separated by a groove on the marginal face. The handle is 87 cm. long and is fitted with a wide band of plaited cane above and below the stone head to hold it in position, and it is further secured with a narrow bamboo wedge driven down the shaft inside the upper plaited band. Collected at Kaimari, Gulf of Papua, by A. R. McCulloch.

48.—E.19 (Plate xi, fig. 33). A polished dark igneous club-head 11 cm. in diameter, 2·8 cm. thick, with a hole 2·5 cm. and low ridged lip 3·5 cm. in diameter. It has a single row of seven large rounded points, and its surface is polished over pecking. The bamboo handle is 66 cm. long, and a bamboo wedge has been driven into its end to secure the stone head. A narrow plaited shoulder strap is attached to the shaft. Fly River, western Papua.

49.—A.15563 (Plate xi, fig. 34). A polished grey andesite club-head 12 cm. long, 6 cm. thick, with a hole 2 cm. and high ridged lip 3·5 cm. in diameter. It has three long points, lozenge-shaped in transverse section, one pair being 4 cm. long and the other one 5 cm. long, each separated by a pair of small rounded knobs one above the other. The handle is 68 cm. long and has a narrow plaited band of cane above and below the stone head to hold it in position. Koiari tribe, Port Moresby, Papua.

Remarks.—The majority of the stone club-heads are featured by a ridged lip similar to that on the mortars. The hole may be hollowed half-way through from each side, or three-quarters from one side and one-quarter from the other; in the latter examples it is sometimes at an oblique angle. A study of the methods of fixation of the head on the shaft should make possible a more accurate determination of the large number of specimens in museums marked "New Guinea". It is important, also, to establish the variety of prehistoric types of club-heads for comparison with the modern types as a means of providing more accurate data for comparisons of prehistoric cultures from south-east Asia and Oceania.

The introduction of the pecking technique was an important event in the history of stone working in Oceania. It enabled man to fashion a piece of stone into almost any shape he desired, and particularly to produce rounded surfaces. Thus we find as this early Neolithic technique spread into Oceania there took place a remarkable development in the production of well-shaped mortars and pestles, animal and human figures, club-heads and other objects of which the collection herein described is typical. Throughout Indonesia, Melanesia and Polynesia a great variety of pecked stone objects and implements have been recorded, and in Australia the technique was applied to a wide range of implements. The prehistoric implements described (Nos. 1–42) show clearly that pecking preceded polishing in the chronology of stone-working techniques.

EXPLANATION OF PLATES VIII–XI.

Plate viii.

1.—Prehistoric mortar dredged up amongst alluvial gravels at the lower end of the Bulolo Valley.

2-4.—Prehistoric mortars from the Iani-Halumgali portion of the Wahgi Valley, Central New Guinea.

Plate ix.

5.—"Bark-cloth beater" found in a prehistoric mound on San Cristoval, Solomon Islands.

6.—Club-head from the Iani-Halumgali portion of the Wahgi Valley, Central New Guinea.

7.—Implement dredged up amongst alluvial gravels at the upper end of the Bulolo Valley. Type used by modern natives as a "bark-cloth beater".

8.—Bark-cloth beater, Huon Gulf.

9.—Prehistoric pestle from Papua.

10-13.—Prehistoric club-heads from the Iani-Halumgali portion of the Wahgi Valley, Central New Guinea.

Plate x.

14.—Head of a mammal or bird found in a hillside, after a landslide, between Bena Bena and Mt. Hagen.

15.—Figure of a pigeon found in a hillside, after a landslide, between Bena Bena and Mt. Hagen.

16.—Small mortar found in a hillside, after a landslide, between Bena Bena and Mt. Hagen.

17.—Ventral view of prehistoric figure of a bird from the Iani-Halumgali portion of the Wahgi Valley, Central New Guinea.

18.—Head of a prehistoric pestle from the Iani-Halumgali portion of the Wahgi Valley, Central New Guinea.

19.—Abrading stone found in a hillside, after a landslide, between Bena Bena and Mt. Hagen.

25.—Club-head from the Iani-Halumgali portion of the Wahgi Valley, Central New Guinea.

23.—Prehistoric club-head from the Iani-Halumgali portion of Wahgi Valley, Central New Guinea.

24.—Prehistoric club-head from Mt. Hagen, with lump of stone attached.

25.—Club-head from the Iani-Haulmgali portion of the Wahgi Valley, Central New Guinea.

Plate xi.

26-28.—Prehistoric mortars from the Iani-Halumgali portion of the Wahgi Valley, Central New Guinea.

29-35.—Stone-headed clubs used by modern New Guinea natives. This series of head types is not represented in Haddon's classification of these implements.

Photos—Howard Hughes.

THE IDENTITY OF A SUPPOSED HUMAN MOLAR FROM THE WELLINGTON CAVES OF NEW SOUTH WALES.

By H. H. FINLAYSON.

(Plates xii-xiii; and Figure 1.)

In 1870 appeared the first publication of the finding by Gerard Krefft(1) of a portion of a human molar tooth in the Wellington Caves of New South Wales. After a period of uncertainty as to the exact circumstances of the find it was established that the fragment, though developed from its matrix shortly after its discovery, was originally embedded in the characteristic cave breccia in association with extinct marsupials such as *Diprotodon* and *Thylacoleo* at a period estimated by David(5) to be from 7,000 to 12,000 years ago.

Since its first identification the fossil has been written upon at greater or less length by Krefft(2) in 1874, Etheridge,(3) 1890 (who quotes the opinion of Pedley), Etheridge(4) 1916, David(5) 1923, and Anderson(6) 1933, all of whom have apparently accepted the human origin of the fragment, and Anderson's remark (op. cit.) that "it is one of the best pieces of evidence as to the early existence of man in Australia" embodies a view which seems to have been very generally accepted.

In a recent re-examination of the tooth by Dr. T. D. Campbell(7) its human relationships have been strongly contraindicated and at his suggestion I have considered *de novo* its possible relation to the lower mammals. To this end the morphology of the fragment and the type and sequence of the attrition which has produced its crown pattern have been minutely compared with all indigenous Australian mammals, with all introduced and domestic mammals, and with many exotic species as well, which could possibly yield a dental fragment of the size of the fossil. As a result there would now appear no reasonable doubt that the fossil is derived from the Pleistocene macropod *Macropus* (*Protemnodon*) *anak* Owen, a giant "Wallaby", remains of which are already known from the Wellington Caves, and which also occur in profusion in beds of similar and earlier age over a large part of eastern and south-eastern Australia.

Preliminary consideration of the general dental anatomy of the fossil brings one to conclusions which have an important bearing on the subsequent examination of its detail.

Regarded as a *molar*, its outstanding peculiarities are, firstly, its extreme functional brachydonty and, secondly, the simultaneous presence in juxtaposition upon the occlusal surface of large exposures of dentine, with broad major enamel features. While both these conditions may be found separately in several groups of mammals, their concurrence in one species is generally precluded by the structural ground plan of the tooth. In the great majority of molars reduction of the enamel of the wall of the crown to the relative level which obtains in the fossil, simultaneously reduces the occlusal surface to a featureless expanse of dentine, while the few forms among the polyprotodont marsupials and lower carnivores, in which the requisite degree of brachydonty pre-exists, are incapable of yielding the occlusal surface.

This fundamental peculiarity in the structure of the fragment early led the writer to abandon the "molar theory" of its origin altogether. On transferring attention to premolar teeth, close analogies in ground plan were discovered amongst the 3rd and 4th premolars of the Macropodinae. Teeth of both these categories are, however, in the intact or moderately worn state, such as is usually seen, narrow and high-crowned with strongly developed trenchant and perforant functions, and therefore in marked contrast to the flat-surfaced triturating fossil. In much-worn examples, however, especially in P^4 of the upper series, this contrast disappears, and on examining large numbers of such, several examples were found to show patterns of the occlusal surface, very similar to that of the fossil. Further, a study of the successive stages of attrition through which such teeth have passed, correlates in the clearest way all the main structures of the fossil with their originating centres in the unworn seccator, and indicates that in many species of macropods its characteristic occlusal pattern must be produced as a transient and quickly obliterated phase.

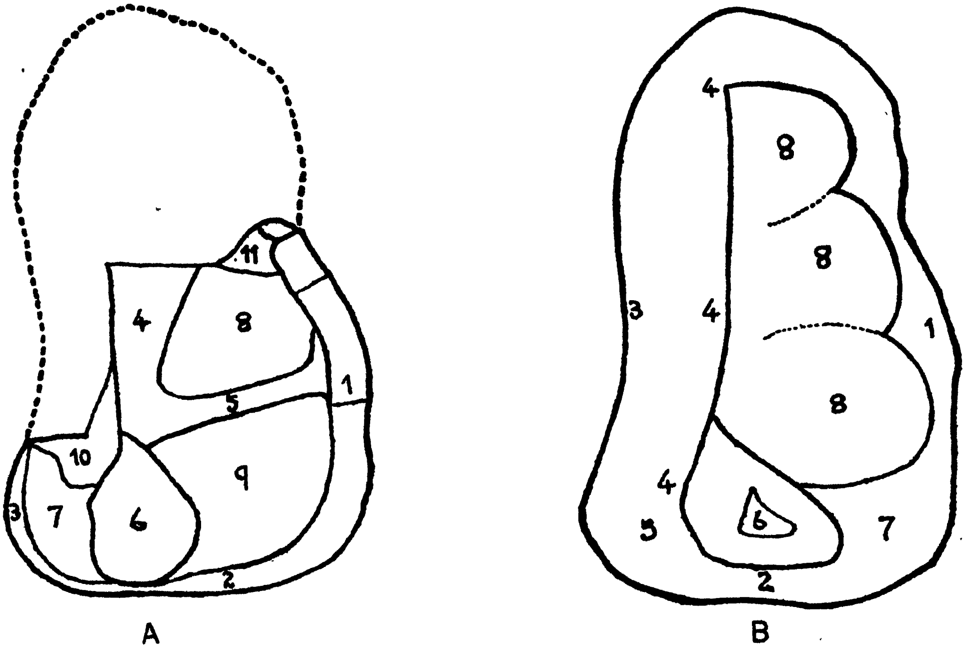

Figure 1.

Diagram correlating the main structures of the occlusal surface of (A), the fossil from the Wellington Caves, with (B) their originating centres in an unworn right upper fourth premolar (seccator) of a type found in *Macropus* (*Protemnodon*) *anak*.

(A). 1, enamel band of part of the lingual (internal) margin; 2, enamel band of the entire posterior (proximal) margin; 3, enamel band of part of the buccal (external) margin; 4, the cuneiform facet; 5, the transverse element; 6, the pyriform facet; 7, the reniform facet; 8, the anterior fossa; 9, the posterior fossa; 10, the second dentine exposure; 11, the third dentine exposure.

(B). 1, the lingual (internal) margin; 2, the posterior (proximal) margin; 3, the buccal (external) margin; 4, free crest of the main blade; 5, the posterior cusp of the main blade (postero-buccal cusp); 6, the posterior fossette; 7, the postero-internal or talon cusp (postero-lingual); 8, anterior, median, and posterior segments of the internal ledge.

The fossil, in the present view, represents the posterior half of the upper fourth premolar (seccator) of the right side of *Macropus* (*Protemnodon*) *anak* Owen in a very advanced state of wear. Among the teeth of *M. anak* which have been used for direct comparison, and in the figures of the same by Owen(8) and DeVis,(9) are several which qualify in dimensions and structure as potential originators of such a fragment, though none presents the requisite stage of wear. However, the existing Black Tailed Wallaby, *M.* (*Wallabia*) *ualabatus* L. and G., has a dentition similar to that of *anak* both morphologically and in its attrition sequence, and has been available in sufficient numbers to yield both the crown pattern of the fossil and stages earlier and later than this, which are in close agreement with the examples of *anak* in hand.

In previous descriptions the cusp nomenclature and general orientation adopted have been based on or influenced by the assumption of its human origin and are unsuitable for illustration of the present conclusions. A brief redescription is therefore provided in which the orientation of the parts is altered to conform to this view of its identity, and in which general descriptive terms are employed to indicate the main morphological features of the fragment; these features are then homologized in detail with those of the macropod seccator in general and of *M. anak* in particular.

The fossil (Text-fig. 1A; Plate xii, figs. C, G; Plate xiii, figs. B, C, D) is a thin plate-like fragment of irregular shape, comprising portion of a crown of a tooth separated from its roots by a fracture through the cervix. Its transverse diameter from the buccal to the lingual margin near the posterior angles is 10·7 mm.; its maximum antero-posterior diameter is 11·1 mm.; and its maximum depth near the posterior angle of the buccal wall is 6·0 mm. Of these dimensions the first only is of value here as a specific test and it lies well within, though towards the upper limit of, the range of variation for this diameter in *M. anak* (*sen. lat.*). The outline of the crown from the occlusal aspect is bounded by fracture lines over most of the buccal and distal margins, but the remainder is intact and has smoothly rounded posterior angles, the whole rather suggesting derivation from a simple quadrate tooth, except that at the anterior lingual site the re-entrance of the curve is less than at the posterior angles and foreshadows an anterior extension of the tooth there. The marginal outline is very similar to that of worn examples of *anak*, except possibly for this same anterior lingual section which has a buccal inclination steeper than in examples which I have had in hand, though the condition is approached in one of Owen's(8) figures (Pl. lxxxvii, fig. 9). The discrepancy is less than would be inferred from a comparison of fig. D with fig. C of Plate xii, the margin in D being represented at a much higher level than in the fossil. It may be noted that in this detail the fossil may be nearer the third premolar of *anak* than the fourth, but as there is little else in support of such an identification, it is here ascribed to individual variation of the seccator.

Of the lateral walls of the crown both the posterior and lingual are complete vertically, being bounded below by the cervical dentine, and the posterior is complete horizontally as well. Both are of interest as illustrating the degree of denudation of enamel which has taken place, and the posterior carries an important attrition feature. The buccal wall is represented by a remnant only at its posterior extremity, and this shares the characters of the adjoining posterior wall.

The posterior (proximal) wall (Plate xii, fig. G) attains its maximum height of enamel (6·0 mm.) at the buccal angle, thence declining to a minimum of 2·0 mm. on the lingual side of the centre, and rises again slightly to 2·6 mm. at the lingual angle. Its occlusal profile is thus rather markedly concave, while the lateral profiles are both convex. At the cervix the junction with the dentine is a shallow sigmoid with its major convexity opposing the concavity of the free profile; in virgin or slightly worn seccators of most macropods this cervical junction is strictly transverse or nearly so (Plate xii, figs. E and H) and the sigmoid condition is definitely an age character (Plate xii, fig. F).

Nearly half of the surface of the posterior wall towards the buccal margin is occupied by an interdental attrition facet hollowed out into a shallow depression which is divided further by ridges of low relief into three compartments, the upper of which is scored by a series of minor parallel incisions. The feature differs markedly from the flat interdental facets commonly developed on the molars of many mammals, but is highly characteristic of the macropod fourth premolar. In the production of the usual type of facet between molars the teeth are opposed to one another on about the same level and the planing effect is produced between two surfaces. In the macropod jaw, however, in adult life, the first molar abuts on a fourth premolar which has a much higher crown. The resulting interdental attrition takes the form of a gouging effect of the anterior rim of the molar upon the posterior wall of the premolar and tends to the production of shallow polished grooves, which vary markedly in pattern and site with the age of the animal. These variations are partly due to the different rates at which the crowns of the two teeth are reduced in height, partly to alveolar instability of the molar as age advances, but still more to the well-known slow forward movement of the whole molar series against the premolar. This results in the first molar being pushed across the rear wall of the premolar from the lingual to the buccal side, where (in a disintegrating state) it is finally shed. The facet tends to shift in the same direction, being usually found on the lingual side in young animals, where it is soon obliterated by the planing down of the occlusal surface, and in old age towards the buccal side, where it finds a permanent refuge after the molar has gone. The first and an intermediate condition are well illustrated by a slightly worn example of *M. anak* (Plate xii, fig. H) and the last by the fossil and an aged example of *M. ualabatus* (Plate xii, figs. G, F).

On the lingual wall (Plate xiii, fig. C) the enamel is deepest in the middle (3·2 mm.), declining to 2·5 mm. at the posterior angle and 1·8 mm. at the anterior; its occlusal profile is thus slightly convex. The enamel-dentine junction at the cervix is slightly concave to the occlusal. In the seccators of *M. anak* in hand, and especially in the example figured, the lingual wall is marked by a deep notch at the posterior third of its length, towards which the cervical enamel line dips from both sides; such teeth would scarcely be expected to yield the nearly rectilinear junction of the fossil, in which the notch is represented by a mere indentation. However, the detailed sculpture of the lingual wall in *anak* is apparently variable, as it is in some recent species. In an example figured by Owen(8) (Plate lxxxiv, fig. 15) the condition is substantially as in the fossil.

Towards the posterior margin of the fractured surface of the radical aspect of the fossil (Plate xiii, fig. B) a remnant of a pulp cavity persists in the form of a transversely elongate hollow of dimensions 5 × 1·5 mm. It is shallowest in mid-course, descending at either extremity to small outwardly diverging cornua, and is in close agreement with a corresponding cavity in a seccator of *M. anak* fractured at the same level.

The occlusal surface (Text-fig. 1, A; Plate xii, fig. C) has been planed down by wear to an almost flat triturating base which slopes from its highest point on the buccal margin to a slight antero-posterior trough lying on the lingual side of the central axis, thence rising slightly to the inner margin. In view of the degree of wear which it has sustained, it presents a surprising development of enamel structures which, though in very low vertical relief, are discrete and easily traced and, together with the areas they enclose, are of decisive importance in the identification.

Along the central axes of the plane lies a three-membered enamel structure of roughly trefoil pattern, raised noticeably above the surrounding areas. Although the three arms are conjoined at a common centre, they arise from functionally distinct portions of the original tooth and will be considered separately.

(1) A pyriform facet (Text-fig. 1A, 6) forms the posterior or proximal element of the trefoil and has its base on the posterior margin of the tooth and its apex at the common centre of the three. Its surface is highly polished and bevelled off by wear towards the postero-lingual angle, and its edges are sharply angulated but, except possibly to a small extent at its antero-buccal corner, have not been modified by fracture. At its postero-lingual angle its surface is marked by a shallow sulcate stigma. This characteristic feature of the fossil represents portion of the floor of the posterior

fossette (Text-fig. 1A, 6) of the original seccator, which is enclosed against the inner wall of the postero-external cusp of the main blade by a deep strongly marked enamel fold of V-shaped outline. The fossette occurs in the seccator of many species of macropods and is particularly well developed in *M. anak* and *ualabatus* (Plate xii, figs. D and A). The substance of the floor is dense and resistant and when the enamel walls are completely demolished it remains as a conspicuous disk raised above the surrounding surface. The stigma is a remnant of the deepest recess of the fossette which has escaped complete obliteration by wear, and is a familiar landmark in worn premolars in this group of marsupials, persisting as a pigmented spot towards the posterior margin of the tooth long after the facet as such has disappeared.

At the postero-buccal angle adjoining the pyriform is a reniform facet (Text-fig. 1A, 7) of about the same area, but much less highly polished and bevelled in a different plane. Distally it is bounded by a dentine exposure which also separates its upper course from the pyriform. It occupies the highest portion of the occlusal surface and together with the pyriform and dentine exposure represents an irregularly horizontal section near the base of the original jutting cone of the postero-external cusp of the main blade.

(2) The distal arm of the trefoil is a more elongate cuneiform facet (Text-fig. 1A, 4) lying on the same longitudinal axis as the pyriform. It is abruptly truncated by fracture at its distal extremity and bounded on its buccal margin by an exposure of dentine which has also been fractured. Lingually it is less distinct than the pyriform and tends to merge with the general contours of the anterior fossa. Its surface is bevelled at the same angle as the pyriform but in a plane slightly inclined towards the antero-lingual angle.

In species such as *anak* and *ualabatus*, which possess a continuous uncleft main blade to the seccator, a long faceted strip of enamel bounded by a dentine exposure externally is constantly developed in advanced wear on the posterior and median portions of the lingual slope of the blade (Plate xii, fig. B), and there can be no doubt of the derivation of the cuneiform facet of the fossil from such a strip by truncation distally by a fracture (Plate xii, fig. C).

(3) The transverse element (Text-fig. 1A, 5) is a narrow rib of enamel which passes across the longitudinal trough of the tooth from the junction of the two facets just noted to the lingual margin. Its course is slightly distal of the transverse and undulates with the contours of the trough. It is sharply defined on its posterior side, where it abuts on an area of dentine, but elsewhere merges in a wide enamel expanse, of which it forms the posterior boundary and with which its substance is continuous. It is highly polished but not faceted, except at the junction with the cuneiform facet. It is homologous with the distal sloping anterior wall of the postero-internal cusp or talon of the unworn seccator (Plate xii, figs. A, D) and represents a low level, almost basal section of that structure.

The depressed areas of the occlusal surface are divided by the above transverse element, which acts as a raised septum, into two fossae. The anterior fossa (Text-fig. 1A, 8), which is the shallower, is floored entirely by enamel which is integral with that of the cuneiform facet and the transverse rib, which bound it on two sides. Lingually it terminates in a tumescence abutting on the margin of the tooth, while distally it is open and confluent with a minor dentine exposure at the apex. This fossa represents the median third of the "internal ledge" of the intact seccator, in which it is the lowest portion of the occlusal surface. In the fossil it has sustained less change than any other part and vestiges of the coarse irregular ribbing of its floor, characteristic of *anak*, persist upon it as smooth convolutions.

The posterior fossa (Text-fig. 1A, 9) is entirely floored with yellowish dentine, the limits of which are clearly indicated by sharp discontinuities of its substance with the bluish-white enamel which everywhere surrounds it. Its surface is scored by scratches, probably artificially produced. Its shape is characteristic and of much diagnostic importance—subquadrangular, with the postero-lingual angle suppressed and rounded and the others acute. In this form it may be recognized with certainty as a mere facet on the summit of the lingual angle of the postero-internal cusp or talon in the scarcely worn premolar of *anak* and many other species of macropods (Plate xii, figs. B and D). As it grows in area and deepens with wear its anterior boundary is thrust steadily forward, until the base of the talon wall is reached, when, as in the fossil, it presents virtually a horizontal section of the cusp near base level, 2 mm. above the cervix. Its characteristic shape is retained until the pyriform is engulfed, when it links up with a long strip-like exposure of dentine near the buccal margin, a fragment of which is preserved in the fossil (Text-fig. 1A, 10) and which is shown entire in Plate xii, fig. B. At a still later stage of wear, the dentine exposure of the buccal margin extends across the floor of the internal ledge and appears upon the lingual margin of the tooth. The fossil had reached this third phase and a small portion of this lingual dentine exposure is preserved at the antero-lingual angle of the fragment (Text-fig. 1A, 11).

Finally a conspicuous feature of the occlusal surface, though of less intrinsic importance than the foregoing, is the marginal enamel band (Text-fig. 1A, 1, 2, 3) which everywhere invests its boundary except where removed by the main fracture. It takes the form of a raised highly-polished, smoothly-rounded rim everywhere separated from the structures it encloses, by a hair-like fissure. It is broadest at the postero-lingual angle (1·6 mm.) and is constricted to 0·5 mm. by the interdental facet opposite the base of the pyriform. It is a familiar feature in much worn teeth of several categories in many species, especially after weathering, and in the Macropodidae, has been noted by DeVis as the "basal rim". It presents no features in the fossil which are at variance with the present identification.

While several points of minor discrepancy between the fossil and the corresponding teeth of *M. anak* which have been available have been brought to light by the foregoing examination, they are of no significance when measured against the general agreement in characters of major importance, and may fairly be placed to the account of individual or racial variation. Throughout this comparison *M. anak* has been used in *sensu lato* to embrace the whole *anak-brehus-raechus* complex of species or subspecies, as suggested by DeVis.⁽⁹⁾ The geographical range of this complex in the Pleistocene is fairly closely paralleled by the present range of existing races of *M. ualabatus* which have a similar premolar dentition, and one in which variation is sufficiently wide to justify this view of the discrepancies.

* * * * *

The identification of Krefft's find which is here advanced is necessarily inferential rather than absolute, but the inference is of the strongest and most acceptable kind.

In conclusion, I have to thank the Director and Trustees of the Australian Museum for the opportunity of studying the fossil, and to express my indebtedness to Dr. T. D. Campbell, whose stout and consistent rejection of the human origin of the fragment early brought a clarifying influence to bear on the work.

List of References.

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(3) Etheridge, R., Jnr., 1890.—*Proc. Linn. Soc. N.S.W.*, 5, 262.
(4) ————, 1916.—*Rec. Aust. Museum*, 11, 31-32.
(5) David, T. W. E., 1923.—*Papers and Proc. Roy. Soc. Tasmania*, p. 133.
(6) Anderson, C., 1933.—*Proc. Linn. Soc. N.S.W.*, 58, xxi.
(7) Campbell, T. D., 1948.—*Rec. Aust. Museum*, xxii, p. 200.
(8) Owen, R., 1877.—Extinct Mammals of Australia.
(9) DeVis, C. W., 1894.—*Proc. Linn. Soc. N.S.W.*, x, Pl. xvii.

EXPLANATION OF PLATES XII-XIII.

The teeth figured are upper fourth premolars of the right side, except for D and H of Plate xii, and A of Plate xiii, which represent the same tooth of the left side. In D and H of Plate xii the image has been laterally transposed to facilitate comparison.

PLATE XII.

Fig. A.—Occlusal aspect of the unworn tooth in *Macropus* (*Wallabia*) *ualabatus* (× 5·2).

Fig. B.—Occlusal aspect at an advanced stage of wear in *Macropus* (*Wallabia*) *ualabatus* (× 6·0). Illustrating the development of the characteristic attrition pattern of the fossil, in a much smaller recent species.

Fig. C.—Occlusal aspect in the *fossil* (× 3·0). (Australian Museum Collection, registered number, F1438.)

Fig. D.—Occlusal aspect in a moderately worn tooth of *Macropus* (*Protemnodon*) *anak* (× 3·0). Showing structural relations to the fossil (which has similar dimensions) parallel to those shown by A to B.

Fig. E.—Posterior wall and cervical region of specimen figured in A (× 7·0).

Fig. F.—Posterior wall and cervical region of specimen figured in B (× 6·2). Showing conditions in marginal profile, interdental facet and cervical junction, induced by wear and similar to those of the fossil.

Fig. G.—Posterior wall and cervical region of the fossil (× 3·2).

Fig. H.—Posterior wall and cervical region of the specimen figured in D (× 3·0). Showing relations to the fossil parallel to those of E to F.

PLATE XIII.

Fig. A.—Lingual aspect of the tooth in *Macropus* (*Protemnodon*) *anak* (× 3·0). Showing further the general characteristics of the tooth from which the fossil was derived by advanced attrition. (The view is sublateral to disclose the full height of the blade).

Fig. B.—Radical aspect of the fossil (× 3·0). Showing remnant of pulp cavity (oblique view).

Fig. C.—Lingual aspect of the fossil (× 3·0).

Fig. D.—Buccal aspect of the fossil (× 3·0).

Photos.—H. H. Finlayson.

A REVISION OF THE AUSTRALIAN GYRINIDAE.

By Georg Ochs,

Dachau, Germany.

Determination of Australian Gyrinidae is difficult. Publications on this family are very scattered and nowhere is there a comprehensive paper on this fauna. There are two handbooks on Australian insects,[1] but in both the Gyrinidae are treated only cursorily. In the Catalogue of the Described Coleoptera of Australia by George Masters (*Proc. Linn. Soc. N.S.W.*, Vol. 10, 1885) nearly all species named up to that time are registered, but without critical selection, and several species are recorded more than once under different names, even in different genera. In the Coleopterorum Catalogus, Pars 21, 1910, Ahlwarth repeats many of these mistakes, as at that time the complicated synonymy of several Australian species was not settled in a satisfactory manner.

In order to relieve this situation, I intended to make a study of the Australian species of Gyrinidae many years ago, and my request for material was answered generously by the Australian museums, which placed at my disposal the specimens of the family represented in their collections. Unfortunately, the material assembled at that time was not sufficient, and I was forced to delay my task until 1938, when, through the kindness of Dr. P. J. Darlington, junior, I received for study a very numerous collection of Australian Gyrinidae captured by him during the Harvard Expedition, 1931–1932, now in the Museum of Comparative Zoology at Harvard College, Cambridge (Massachusetts).

This material, augmented by supplementary series from other collections, allowed me to undertake a thorough revision of the Australian representatives of the family, the accomplishment of which was again delayed, as war arose, and could be finished only now despite many difficulties.

The present paper comprises all species of the family known to occur on the Australian continent and the adjacent islands, except those which are recorded from these countries evidently in error. The keys will enable the student to make correct determinations of genera and species, and every species is furnished with, I believe, a rather complete bibliography, by which I hope all synonymic questions will be settled in a satisfactory manner. All records of Australian Gyrinidae, which came to my knowledge, are recorded, thus illustrating the distribution of the different species, and in an appendix are discussed zoogeographical and phylogenetical questions in connexion with the Australian gyrinid fauna.

The author makes acknowledgments to all those by whose assistance he was enabled to make this study, especially to Dr. P. J. Darlington, jr., of the Harvard College at Cambridge, Massachusetts, for the specimens collected during his trip to Australia in 1931–1932. Moreover, I am greatly obliged to the authorities of the Queensland Museum at Brisbane, the Australian Museum and the Macleay Museum at Sydney, the South Australian Museum at Adelaide, the British Museum in London, the Naturhistoriska Riksmuseum at Stockholm, the Deutsches Entomologisches Institut at Blücherhof, and many others for loan of material and other kindnesses. I am especially indebted to Prof. Richter and Dr. Elli Franz, of the Senckenberg Museum at Frankfort-on-Maine, for preservation of my collection, as without their intervention the latter would have been probably lost by the events of the war, in which case I would have been prevented from further study of the family.

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[1] Froggatt, W. W.: Australian Insects. Sydney, 1907.
Tillyard, R. J.: The Insects of Australia and New Zealand. Sydney, 1926.

Key to Australian Subfamilies and Genera.

1. Suture of elytra with a small border. Length[1] 4 to 6·5 mm. (Gyrininae.) 2
2. Length 4 to 4·5 mm. Sides not bordered with yellow .... *Gyrinus*
2'. Length 5·5 to 6·5 mm. Sides bordered with yellow .... *Aulonogyrus*
1'. Suture of elytra not bordered. Length more than 6·5 mm. (Enhydrinae.) 3
3. Scutellum visible .... *Macrogyrus*
3'. Scutellum invisible .... *Dineutus*

Genus Gyrinus Linn., 1767.[2]

Size 3·5 to 8 mm., most of the species measuring about 5 mm. Dorsal eye anterior to ventral eye. Pronotum marked by an impressed and mostly punctate line along the lateral portion of the anterior margin, by a more or less impressed transversal groove on the disc, and by an oblique lateral groove on both sides of the posterior portion. Bordered with yellow only exceptionally. Propygidium not or only slightly trilobed. Anterior legs slender and but scarcely modified.

This genus, represented in Australia practically only by one species,[3] has a world-wide distribution. The most specialized species live in the Neotropic region, whence 2 subgenera are recorded (*Neogyrinus* Hatch 9, *Oreogyrinus* Ochs 16 species). The most numerous is the Holarctic group (Nearctic 44, Eurasian 18, East-Asiatic 9 species, including the subgenus *Gyrinulus* Zaitzev). The Australian representative belongs to the Gondwana group (Ethiopic 9, Madagascan 4, Indo-Australian and Pacific 8 species).

Gyrinus convexiusculus Macleay.

Gyrinus nitidulus Aubé, 1838, Spec. Col., 6, 700 (partim); Motsch., 1861, Bull. Soc. Imp. Moscou, 34, 109.
convexiusculus Macleay, 1873, Trans. Ent. Soc. N. S. Wales, 2, 128.
huttoni Pascoe, 1877, Ann. Mag. Nat. Hist., (4) 19, 141; Broun, 1880, Man. N. Zeal. Col., p. 76.
simoni Rég., 1883, Ann. Soc. Ent. France, (6) 3, 163.
convexiusculus Rég., 1883, Ann. Soc. Ent. France, (6) 3, 166, pl. 6, f. 88; Fauvel, 1883, Rev. Ent., 2, 349; Rég., 1884, Ann. Soc. Ent. France, (6) 3, (1883), 474.
simoni Rég., 1884, Ann. Soc. Ent. France, (6) 3, (1883), 474.
convexiusculus Masters, 1885, Proc. Linn. Soc. N. S. Wales, 10, 598.
huttoni Rég., 1886, Ann. Soc. Ent. France, (6) 6, 257, 271.

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[1] All measurements are taken from anterior margin of labrum to the tip of elytra, not including the protruding portion of abdomen.

[2] *Gyrinus* was first mentioned by Linnaeus in 1733 in ed. 1 of his Systema Naturae, referring to the insect which is regarded now as the type of the genus and of the family. In 1758, however, in the 10th edition, which is the base of modern nomenclature, the author placed this animal in the genus *Dytiscus*, and in ed. 12, 1767, he reestablished the genus *Gyrinus*. Meantime, in 1762, the latter was perfectly described by Geoffroy in his "Histoire abrégée des insectes qui se trouvent aux environs de Paris". However, this author did not use binominal nomenclature in this publication, which is ineffective according to the Rules of Nomenclature. Recently (*Ann. Mag. nat. Hist.*, ser. 11, vol. 12, 1945, p. 110, J. Balfour-Browne is inclined to ascribe the authorship of *Gyrinus* to O. F. Müller, who in his doubtlessly binominal publication of 1764 (*Fauna Insectorum Fridrichsdalina*) gives a recapitulation of the classificaton of Geoffroy, and cites *Gyrinus* on p. XVII, Nr. 50, accompanied by a short diagnosis. I was ready to follow the opinion of Mr. J. Balfour-Browne when Mr. Per Brinck, a very ardent Swedish entomologist, drew my attention to the fact that in the main part of Müller's publication there is to be read on p. 19, Nr. 193: "*Dytiscus natator* ovatus glaber, antennis capite brevioribus obtusis", from which it seems that Müller himself disowned a generic separation of *Gyrinus*. In this case the mentioning of *Gyrinus* by Müller on p. XVII is to be regarded as a simple citation without the intention of confirming a genus, wherefrom results that *Gyrinus* Linn., 1767, would be the first exact quotation of the genus.

[3] In older publications several species are recorded as *Gyrinus*, which are now placed in other genera established later on, viz.: *Aulonogyrus strigosus*, *Macrogyrus oblongus*, *Macrogyrus striolatus*, *Dineutus australis*.

convexiusculus Sév., 1889, Ann. Soc. Ent. Belge, 33, 162.
huttoni Sév., 1889, Ann. Soc. Ent. Belge, 33, 164.
simoni Sév., 1889, Ann. Soc. Ent. Belge, 33, 167.
convexiusculus Sév., 1890, Bull. Soc. Ent. Belge, 34, 194.
simoni Rég., 1892, Ann. Soc. Ent. France, 60, (1891), 678, 743.
convexiusculus Rég., 1892, Ann. Soc. Ent. France, 60, (1891), 743.
huttoni Rég., 1892, Ann. Soc. Ent. France, 60, (1891), 745.
convexiusculus Fauvel, 1903, Rev. Ent., 22, 254; Jacobs, 1905, Käfer Russl., p. 438; Rég., 1907, Ann. Soc. Ent. France, 76, 169, 171.
simoni Rég., 1907, Ann. Soc. Ent. France, 76, 169.
convexiusculus Zaitzev, 1908, Rev. Russe Ent., 7, (1907), 242; Ahlw., 1910, Col. Cat., 21, 18.
simoni Ahlw., 1910, Col. Cat., 21, 24.
convexiusculus Mjöb., 1916, Ark. Zool., 10, 9.
simoni Mjöb., 1916, Ark. Zool., 10, 9.
convexiusculus Zimmerm., 1917, Ent. Mitt., 6, 163; Peschet, 1923, Opusc. Inst. Sci. Saigon, 1, 7; Ochs, 1924, Ent. Bl., 20, 229; Winkler, 1924, Cat. Col. Pal. 2, 289.
huttoni Till., 1926, Ins. Austral. N. Zeal., 194.
convexiusculus Ochs, 1926, Ent. Z. Ffm., 40, 114; Ochs, 1927, Suppl. Ent., 15, 115, 121; Ochs, 1928, Ent. Bl., 24, 42; Ochs, 1929, Ent. Bl., 25, 197; Ochs, 1929, Rec. Ind. Mus., 31, 241, 246, 248; Ochs, 1930, Cat. Ind. Ins., 19, 5; Ochs, 1931, Arch. Hydrobiol., Suppl. 8, 462, 464, 466, 477, 478, 481; Ochs, 1931, Lingnan Sci, J.. 7, (1929), 716; Wu, 1932, Peking Natur. Hist. Bull., 6, 65; Cheo, 1933, Peking Natur. Hist. Bull., 7, 317; Cheo, 1934, Peking Natur. Hist. Bull., 8, 212, 218, pl. 2, f. 7, 28; Ochs, 1935, Rev. Ent., 5, 125; Bertr., 1935, Arch. Hydrobiol., Suppl. 14, 218, pl. 3 f. 1; Ochs, 1940, Ark. Zool., 32 A, Nr. 14, 3; Corbet, 1945, Entomologist, p. 2; J. Balf.-Browne, 1945, Entomologist, p. 3.

Length 3·5 to 4·75 mm. Oval, somewhat elongate, attenuated to both ends, rather convex. Upper surface shining, black, bronzed laterally; beneath black, last abdominal segment darkly rufous, epipleura more or less and legs rufescent. Elytral apex somewhat obliquely truncate, slightly convex, exterior angle obtuse, broadly rounded, almost obliterated, sutural angle almost rectangular, also rounded. Serial punctures on the elytra fine near the suture and strongly reduced towards the apex, the outer ones larger and more deeply impressed. Side margin of elytra moderately broad, nearly parallel from base to apex. Aedeagus of the male gradually narrowing from the base towards the middle, distal half nearly parallel, tip rounded.

Type locality is Gayndah on the Burnett River in Queensland. I have seen specimens from Cairns, Brisbane and Sydney. The species is widely distributed and was recorded from Ceylon, India, Tibet (?), S. China, Sumatra, Java (?), New Zealand and New Caledonia.

Although there is some variability among the specimens from different localities, I was not able to find a racial or even a specific difference. Of the Australian specimens, those from Cairns are the smallest, the largest specimens in my collection being those collected near Sydney.

Régimbart, in his monograph, has mentioned a second Australian species, *G. simoni*, which, according to his description, would be larger than *G. convexiusculus*, less convex and more attenuated to both ends. Moreover, the epipleura are said to be more distinctly reddish, the two last abdominal segments brightly red beneath, elytra more distinctly truncate, their outer angle less rounded, outer strial punctures less impressed, lateral margin narrower and reaching the middle of truncature.

All these characters were found to be variable in large series of *G. convexiusculus* to a certain degree, from which I believe that *G. simoni* cannot be considered a distinct species. A specimen in the collection of the Deutsches Entomologisches Institut at Dahlem, near Berlin, which corresponded very well with the description of *G. simoni*, did, however, not appear to represent a distinct species when compared with *G. convexiusculus*. Another specimen seen, belonging to the Hamburg Museum (ancient collection Godeffroy) and determined by Régimbart himself as *G. simoni*, was more convex than *G. convexiusculus* generally, with totally dark epipleura, from which it appears that even the author was not able to distinguish with certainty his own species. Some specimens in my collection, which I had received from an Australian museum, labelled Queensland, Sandgate 3.8.1913 (H. Pottinger), might belong as well to *G. convexiusculus* as to *G. simoni*, so I am inclined to consider the latter only a synonym of the former.

Gyrinus sericeolimbatus Rég.

This species is not yet recorded from Australia, but having a similar distribution to *G. convexiusculus* and having been collected in Papua, Rawlinson Range, it might possibly occur also somewhere in N.E. Australia. *G. sericeolimbatus* is easily recognizable and can be characterized briefly as follows: Length 3·5 to 4·5 mm., shortly oval, strongly convex, 7th interstice on elytra evidently convex, upper surface strongly alutaceous and therefore of a silky lustre, sides of elytra broadly bronzed.

Gyrinus ahlwarthi, n. sp.

I add here the description of a new species of *Gyrinus*, which, although not Australian, is very near to *G. convexiusculus*.

♀. Length 4 mm. Oval, slightly elongate, attenuated to both ends, exceptionally convex. Upper surface shining, black with bluish reflections, laterally slightly bronzed; under-surface black, epipleura slightly rufescent, legs and the last two abdominal segments rufous. Elytral apex somewhat obliquely truncate, exterior angle obtuse, slightly rounded, sutural angle almost rectangular, shortly rounded. Serial punctures distant and fine near the suture and strongly reduced towards the apex, outwards more approximate, larger and more strongly impressed; outer interstices strongly convex. Side margin very narrow, nearly parallel from base to apex.

Type locality.—Dutch New Guinea, Samberi, 25.vi.1910 (Moszkowski, Nr. 38).

Type.—One ♀ in the Zool. Museum of the University of Berlin; paratype in my collection. The specimens were labelled by Ahlwarth and marked by him as representing a new species.

G. ahlwarthi is closely allied to *G. convexiusculus* but specifically different at all events. It is easily to be distinguished by its shorter and much more convex body. The two last abdominal segments are bright red beneath, the upper surface with a bluish hue and the elytra less bronzed laterally.

Even more convex than *G. gestroi* from Japan, which, however, is broader and not so regularly oval and has the outer serial punctures less impressed. Also more convex than *G. nitidulus* (Mauritius and Bourbon), but the side margin of elytra not enlarged and bent upwards posteriorly as in the latter.

Genus Aulonogyrus Rég., 1883.[1]

Size 4·5 to 10 mm., most of the species measuring about 6 mm. Dorsal eye scarcely anterior to ventral eye. Pronotum smooth. Elytral striae present as deep furrows laterally and as finer opaque or metallic lines towards the suture. Frequently bordered with yellow. Propygidium strongly trilobed. Anterior legs slender and scarcely modified.

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[1] The first to use the name *Aulonogyrus* was Motschulsky (1853, Hydrocanth. Russie, p. 9). As his publication is, however, not accompanied by any indication, diagnosis or description, it is a nomen nudum according to the Rules of Nomenclature, and authorship is to be credited to Régimbart, who added to the name a perfect description in part 2 of his Monograph on the Gyrinidae (cf. Balf.-Browne, Ann. Mag. Nat. Hist., ser. 11, vol. 12, 1945, p. 106).

This genus is certainly of Gondwana origin, as proved by its distribution. Its centre of dispersal is in the Ethiopian region (28 spec.), *A. insularis* was recently described by Mr. Brinck from the island of St. Helena, 2 species are Mediterranean, 4 very developed species are Madagascan, 1 is recorded from Ceylon and S. India, 1 from N. Caledonia, 1 from Australia.

Aulonogyrus strigosus (Fabr.).

Gyrinus strigosus Fabr., 1801, Syst. Eleuth., 1, 276; Schönh., 1808, Syn. Ins., 1, 2, p. 39; Forsberg, 1821, Nov. Act. Upsal., 8, 312.
Gyrinus striatus v. *strigosus* Boisd., 1835, Fn. Ent. Oc. Pac. Voy. Astrolabe, 2, 53.
(?) *Gyrinus obliquatus* Macleay, 1873, Trans. Ent. Soc. N. S. Wales, 2, 128.
Gyrinus strigosus Rég., 1881, Mém. Soc. Linn. Nord France, p. 110.
Aulonogyrus strigosus Rég., 1883, Ann. Soc. Ent. France, (6) 3, 131; Rég., 1884, Ann. Soc. Ent. France, (6) 3, (1883), 472.
Gyrinus strigosus Masters, 1885, Proc. Linn. Soc. N. S. Wales, 10, 598.
(?) *Gyrinus obliquatus* Masters, 1885, Proc. Linn. Soc. N. S. Wales, 10, 598.
Aulonogyrus strigosus Sév., 1889, Ann. Soc. Ent. Belge, 33, 160; Rég., 1892, Ann. Soc. Ent. France, 60, (1891), 741; Rég., 1907, Ann. Soc. Ent. France, 76, 161; Ahlw., 1910, Col. Cat., 21, 14; Zimmerm., 1917, Ent. Mitt.. 6, 142; Mjöb., 1916, Ark. Zool., 10, 9, 12; Peschet, 1917, Ann. Soc. Ent. France, 86, 54; Ochs, 1924, Ent. Bl., 20, 233; Ochs, 1927, Kol. Rdsch., 13, 41.

Length 5·5 to 6·5 mm. Elongate oval, moderately convex. Upper surface with a feeble lustre on the posterior portion of the head and on the disc of pronotum and elytra. Colour of upper surface in most specimens dark blue with violet reflections, exceptionally greenish or black. Clypeus, lateral and posterior margin of the head, two dots between the eyes, a transverse line on the disc of pronotum, suture of elytra, longitudinal striae and apical ellipse on the latter metallic, green to coppery. Side margin of pronotum and elytra yellow, with a narrow dark border exteriorly. Under surface metallic black, mesosternum, last abdominal segment and legs rufous, epipleura yellow. Upper surface strongly reticulate and remotely punctate, this microsculpture being somewhat reduced in the shining portions, stronger in the clypeus and in the lateral portions of pronotum and elytra. The latter with ten longitudinal striae, connected two and two posteriorly, the anterior portion of the four outer ones deeply impressed. Inner seven interstices much broader than the four outer ones, 5 and 7 being the broadest. Truncature of elytra strongly convex, sutural angle broadly rounded, external angle more obtusely so. Aedeagus of the male gradually narrowed from base to apical quarter, the latter very narrow, subparallel, tip rounded; lateral lobes very broad, obliquely truncate apically. In the ♀ the apical margin of the last abdominal segment is notched medially beneath.

A. strigosus is strictly limited to Australia and Tasmania. A closely related species, *A. antipodum* Fauvel, is recorded from New Caledonia. In Australia, *A. strigosus* is apparently very common and widely distributed; I have before me the following records:

Victoria: Melbourne; Eltham (H. Pottinger).

New South Wales: Blue Mts. (Taylor); Blue Mts. (G. E. Bryant XII/08); Megalong Valley, 1,000′, 20.1.32 (Harv. Exp., Darlington); Blackheath, 3,000′, 21.1.32 (id.); Sydney; Norton's Basin, Nepean River, 17.X.1920 (Musgrave); Upper Clarence River; Richmond River.

Queensland: Nat. Park, MacPherson Range, 3,000–4,000′, III/1932 (Harv. Exp., Darlington); Brisbane (Hacker, 28.9.24); Christmas Creek, Colosseum XII/1912 (Mjöberg); Evelyne IV/1915 (id.).

S. Australia: Adelaide (Schomb.).

W. Australia: Bridgetown, 8.XI.1931 (Harv. Exp., Darlington); Geraldton, X/1931 (id.).

In Fabricius' description an exact indication of type locality is not given. He mentions only "Habitat in Australasia aquis" and gives the name of the collector "D. Billardière", who was the naturalist of the expedition of d'Entrecasteaux to Australia and the Pacific archipelago. When I revised the collection of Fabricius about twenty years ago no representative of the Australian species was there, but only a specimen of *A. marginatus*, a large S. African species, with label *G. strigosus*. Doubtless this was the specimen discussed by Suffrian, 1847 (Ent. Ztg. Stettin, 8, 100), and which he believed erroneously to be the true *strigosus*. Likewise the *strigosus* of Aubé (1838, Spec. Col., 6, 719) is not to be referred to the Australian species, being identical with *A. striatus* Fabr. occurring in the Mediterranean. From the description given by Fabricius, if thoroughly studied, the Australian species is, however, evidently capable of being recognized, and there is no doubt that it was correctly interpreted by Régimbart (1881 and 1883, *l.c.*) after Forsberg (1821, *l.c.*) and Boisduval (1835, *l.c.*).

In many collections this species is erroneously named *G. obliquatus*, which determination I refer to Macleay (cf. *l.c.*, 1873) and to Masters (cf. *l.c.*, 1885). The true *obliquatus*, however, is a large insect belonging to the genus *Macrogyrus* and living, as described by Aubé (1838, Spec. Col. 6, 661), in the isle of Timor; it is not liable to occur in Australia anyway (cf. Blackburn, 1901, Trans. Roy. Soc. S. Aust., 25, 127; ibid., 1903, 27, 91).

Mjöberg (1916, *l.c.*) mentioned the fact that the natives of N. Queensland catch swarms of *A. strigosus* by means of their "dillybags", roll them up in leaves, roast them in hot ashes and eat them, calling this food "molkom". I supposed (cf. Ochs, 1924, *l.c.*) that this was for aphrodisiac purposes. A similar use of Gyrinid beetles in Europe is reported by Abel and Gross for Stiria.

Genus Macrogyrus Rég., 1882.

Size 6·5 to 18 mm. Scutellum visible. Elytral striae generally well impressed, at least laterally (except *Cyclomimus*). Outer portion of metasternum variable in form. Anterior margin of metacoxae convex, reaching the apical end of metaepisternum; end of raised portion of metacoxae pointed. Anterior tarsi of ♂ generally strongly broadened, oval or attenuated anteriorly, beneath with small suckers, the distribution varying in the species; first joint with a particular area of larger or smaller suckers.

In the older authors the Australian species now figuring as *Macrogyrus* are mostly united with *Enhydrus sulcatus*, a large Brazilian species, the genus *Enhydrus* being well distinguished in several respects. Régimbart, while establishing his genus *Macrogyrus*, still included the South American species inhabiting the Andes, which meantime I had separated in the genus *Andogyrus*. The representatives of the genus *Macrogyrus*, as it is understood now, are still very different in size, general aspect and other minor characters, for which reason I separated two subgenera in 1929/1930 (Ent. Bl., 25, 199; 26, 15). Meantime I devoted myself to a special study of the genus as a whole from which results the following classification:

Key to Subgenera of the Genus Macrogyrus Rég.

1. Outer portion of metasternum narrow, in form of an elongate triangle, outer border only about half as long as the other ones 2

2. Pronotum and elytra bordered with yellow 3

3. Elytral apex with 2 points on sutural and apical outer angle; middle of truncature not or only scarcely pointed .... Type, *M. paradoxus* .. Subg. 1. *Orectomimus* Ochs
Two species in Australia (*paradoxus* Rég., *darlingtoni*, nov.).

3′. Elytral apex with 3 points, middle point very distinct .... (to Subg. 2. *Tribolomimus*, nov.)
One species in Australia (*gouldi* Hope).

2′. Pronotum and elytra not bordered with yellow 4

4. Elytra only with 1 point on the outer apical angle, truncature and sutural angle rounded together, convex .... Type, *M. reichei* .. Subg. 4. *Clarkogyrus*, nov.
One species in Australia (*reichei* Aubé).

4′. Elytral apex with 3 more or less distinct points 5

5. Disc of elytra with several furrows, most of which, if shortened, reach at least half the length of elytra 6

6. Apical 3 points of elytra more or less distinct, never rounded
Type, *M. reticulatus* .. Subg. 2. *Tribolomimus*, nov.
One species in the island of Rotti (*convexus* Ochs); 4 species in New Guinea and neighbouring islands (*reticulatus* Rég., *obsoletus* Rég., *ovatus* Ochs, *variegatus* Rég.); also *M. gouldi* Hope from Australia with yellow border, mentioned above.

6′. Only the outer of the 3 apical points sharp, the other 2 singularly rounded
Type, *M. oblongus* .. Subg. 3. *Australogyrus*, nov.
Three species in Australia (*oblongus* Boisd., *rivularis* Clark, *viridisulcatus* Mjöb.).

5′. Longitudinal striae on elytra very short or nearly obliterated. Apical points obliterated or singularly rounded 7

7. Elytra with transverse scratches, alutaceous sculpture consisting of transverse meshes
Type, *M. leopoldi* .. Subg. 5. *Ballogyrus*, nov.
One species in N. Guinea (*leopoldi* Ball).

7′. Elytra without transverse scratches, alutaceous sculpture consisting of nearly round meshes
Type, *M. purpurascens* .. Subg. 6. *Cyclomimus* Ochs.
Two species in N. Guinea and N. Caledonia (*purpurascens* Rég., *caledonicus* Fauvel).

1′. Outer portion of metasternum broad, in form of a nearly equilateral triangle 8

8. Elytral apex with 3 more or less distinct points
Type, *M. australis* .. Subg. 7. *Tribologyrus*, nov.
Four species in Australia and neighbouring islands (*australis* Brullé, *finschi* Ochs, *elongatus laevis* Ochs, *angustatus* Rég.; 7 species in N. Guinea and neighbouring islands (*albertisi* Rég., *blanchardi* Rég., *elongatus* Rég., *froggatti* Macleay, *oberthüri* Rég., *orthocolobus* Heller, *venator* Boisd.[1]); 3 species in the Sunda Archipelago (*aenescens* Rég., *obliquatus* Aubé, *sumbawae* Rég.).

8′. Elytral apex not pointed, exterior apical angle and middle of truncature indistinctly marked at the most 9

9. Smaller, narrower, elytra with 2 longitudinal striae exteriorly
Type, *M. howitti* .. Subg. 8. *Macrogyrus* J. Balf.-Browne
One species in Australia and Tasmania (*M. howitti* Clark).

9′. Larger, broader, elytra only with 1 lateral stria
Type, *M. striolatus* .. Subg. 9. *Megalogyrus*, nov.
One species in Australia (*M. striolatus* Guérin).

Subg. 1. Orectomimus Ochs, 1930 (Ent. Bl., 26, 15).

Size 6·5 to 9 mm. Elongate-oval, attenuated to both ends, rather convex. Outer (deeper) portion of metacoxae broader than the inner portion, which adjoins the metasternum. Prothorax and elytra bordered with yellow. Truncature of elytra oblique, with 2 distinct points at sutural and outer angle, middle of truncature sometimes but scarcely pointed.

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[1] *M. venator* is recorded in literature as living in Australia, which seems very doubtful, as I did not find any specimen in the Australian material revised. The few examples existing in ancient collections must have been collected either by the Astrolabe Expedition or by Mr. Macleay, who is cited as author of *Gyrinus venator* in the Catalogue of Dejean (ed. 2, 1833, ed. 3, 1837) as in the description given by Boisduval (1835, Voy. Astrolabe, 2, 51). If really Australian, the insect would certainly have been rediscovered. As this is not the case, I believe it to have a local habitat in some island of the Indonesian or Melanesian archipelago, where no collecting has been done for the last 120 years. *M. venator* has a size of about 12 mm. and a broad oval and rather convex form. Elytral striae 3, transverse scratches very feeble; truncature 3-pointed. Anterior tibiae of ♂ strongly curved inwards, anterior tarsi exceptionally narrow.

Key to Species.

1. Smaller (6·5 to 7·5 mm.) and narrower, more attenuated to both ends; very convex. Middle point on truncature of elytra generally absent .... *M. paradoxus* Rég.
1'. Larger (7·5 to 9 mm.) and relatively broader, less attenuated to both ends; rather convex. A weak middle point on truncature of elytra generally present *M. darlingtoni*, nov.

Macrogyrus (Orectomimus) paradoxus Rég.

Macrogyrus paradoxus Rég., 1882, Ann. Soc. Ent. France, (6) 2, 455, pl. 12, fig. 64; 1884, Ann. Soc. Ent. France, (6) 3, (1883), 471; Masters, 1885, Proc. Linn. Soc. N. S. Wales, 10, 598; Sév., 1889, Ann. Soc. Ent. Belg., 33, 158; Rég., 1892, Ann. Soc. Ent. France, 60, (1891), 741; Blackb., 1901, Trans. Roy. Soc. S. Aust., 25, 127; Frogg., 1907, Aust. Ins., p. 135 (partim); Rég., 1907, Ann. Soc. Ent. France, 76, 139, 160; Ahlw., 1910, Col. Cat., 21, 11; Mjöb., 1916, Ark. Zool., 10, 9, 10.

Macrogyrus (*Orectomimus*) *paradoxus* Ochs, 1930, Ent. Bl., 26, 14 (partim).

This is the smallest of the genus, measuring only 6·5 to 7·5 mm. in length, and resembles very much an *Orectochilus* by its very narrow and convex body, which is strongly attenuated to both ends. Upper surface shining, chiefly brownish coloured, with a metallic hue, pronotum and elytra with a yellow border, which is broader than the horizontal side margin, longitudinal striae on elytra brass-coloured; underside pale yellow, in some parts rufescent, epipleura still lighter coloured. Upper surface remotely punctured on head and pronotum, with an alutaceous sculpture consisting of nearly round meshes, which become finer, transverse and very elongate on the disc of elytra. The latter with fine transverse striolae and 4 longitudinal striae laterally, the inner ones being nearly totally obliterated. Apical part of the suture slightly roof-shaped, sides of elytra with a strong impression in the posthumeral portion, at least in the ♀. Truncature of elytra oblique, slightly convex, with 2 points at the sutural and the outer angle; only exceptionally with a scarcely marked third point in the middle of truncature. Labrum produced, nearly semicircular. Anterior tibiae of ♂ strongly dilated towards the apex, triangular, apex obliquely truncate, outer apical angle sharp, slightly produced. Anterior tibiae of ♀ less dilated, anterior tarsi subparallel, strongly dilated and attenuated towards the apex in ♂. Genitalia of the latter yellowish, aedeagus but a little shorter than the lateral lobes, rather broad, subparallel, gradually narrowing in apical third, tip rounded, upper surface with a small groove in the basal portion; lateral lobes very slender basally, broadened only in apical third.

The type specimen was a female, labelled "Australia" with no further indication of locality, from the ancient collection of Wehncke, now in the collection of Mr. R. Oberthür. The species is moreover recorded in literature from N. Australia, Port Darwin (Blackburn, 1901, *l.c.*); Australia (Mus. Brussels, ex coll. Frensch) (Rég., 1907, *l.c.*); Adelaide River (Brit. Museum, vidi!) (Rég., 1907, *l.c.*); N.W. coast of Australia (Froggatt, 1907, *l.c.*); Kimberley, Noonkanbah (Mus. Stockholm, vidi!) (Mjöb., 1916, *l.c.*); Cape York Penins., not far from Alice River (Mjöb., 1916, *l.c.*). I did see further specimens from N.W. Australia (Aust. Mus. and Macleay Mus.), in one of which the middle of truncature is slightly pointed; Victoria, probably in N. Australia (Mus. Dresden); N. Australia, Katherine, Manbulloo Station, 19.7.1929 (I. M. Mackerras and T. G. Campbell, Mus. Cambridge, Mass.). The South Queensland records given by Froggatt, Mjöberg and myself in 1930 (*l.c.*) are probably to be referred to the following species. The specimens collected by Mjöberg in Cape York Peninsula were examined by Dr. Malaise and recognized as belonging to *M. paradoxus*.

Macrogyrus (Orectomimus) darlingtoni, n. sp.

Macrogyrus paradoxus Frogg., 1907, Aust. Ins., p. 135 (partim).
M. (*Orectomimus*) *paradoxus* Ochs, 1930, Ent. Bl., 26, 14 (partim).

Very similar to the former, but larger in size (7·5 to 9 mm.), much broader, less compressed and less attenuated to both ends. Upper surface chiefly olive-coloured, with bluish or violet reflections, longitudinal striae of elytra greenish, yellow margin narrower and better limited inwards; under side darker. Microsculpture as in the former, striolae on elytra more evident. Apical portion of suture not roof-shaped, lateral impression only superficially marked, truncature generally with an obtuse point in its midst. Labrum less produced. Anterior tibiae of ♂ a little broader than in *M. paradoxus*, exterior apical angle more prominent, anterior tarsi longer and more attenuated otwards the apex. Aedeagus darker coloured, otherwise not very different in shape.

Type Locality.—Queensland, Atherton Tableland; Ravenshoe, 3,000 ft., April, 1932 (Darlington).

Type ♂ and allotype ♀ in the collection of the Harvard Universtiy, Inst. of Comparative Zoology, Cambridge (Mass.); several paratypes in my collection.

The distribution of *M. paradoxus* apparently extends from the northern part of Western Australia to Cape York Peninsula. *M. darlingtoni*, closely allied but certainly specifically distinct, seems to succeed *M. paradoxus* in more southerly districts of Queensland.

Besides the typical specimens I have before me a small number of specimens collected in South Queensland: Brisbane, March, 1932 (Darlington), which are a little smaller in size (7·5 to 8·5 mm.) and differ also by having the yellow side margin broader and the truncature of elytra less angulate. These characters, by which a certain resemblance to *M. paradoxus* is produced, are still more evident in specimens from Rockhampton formerly received from the Macleay Museum, but in both cases the features of the body and all other characters are as in the typical specimens.

Subg. 2. **Tribolomimus**, nov.

Size 7·5 to 12 mm. Elongate to broadly oval; more or less convex. Bordered with yellow only exceptionally. Longitudinal striae in elytra more or less impressed, varying in number from 3 to 8 in the different species and being sometimes strongly abbreviated. Apex of elytra generally bitruncate, with 3 well-marked points. The specimens which belong to this subgenus have much affinity with those of *Tribologyrus*, but are easily distinguished by the narrow outer portion of metasternum. Represented in Australia only by 1 species, which is the smallest of the subgenus and the only one bordered with yellow as in *Orectomimus*.

Macrogyrus (Tribolomimus) gouldi (Hope).

Dineutes gouldii Hope, 1842, Ann. Mag. Nat. Hist., 9, 427; Hope, 1842, Proc. Ent. Soc. London, 4, 48.

D. gouldi Rég., 1882, Ann. Soc. Ent. France, (6) 2, 426; Rég., 1884, Ann. Soc. Ent. France, (6) 3, (1883), 470; Masters, 1885, Proc. Linn. Soc. N. S. Wales, 10, 599; Sév., 1889, Ann. Soc. Ent. Belg., 33, 153; Rég., 1892, Ann. Soc. Ent. France, 60, (1891), 739.

Macrogyrus gouldi Blackb., 1903, Trans. Roy. Soc. S. Aust., 27, 92; Rég., 1907, Ann. Soc. Ent. France, 76, 139, 160; Ahlw., 1910, Col. Cat., 21, 10; Mjöb., 1916, Ark. Zool., 10, 9.

Size 7·5 to 8·5 mm. Elongate-oval, rather convex. Upper surface shining, chiefly brownish coloured, with a metallic hue and varicoloured reflections, longitudinal striae in elytra coppery, side margin of elytra and pronotum yellow; under side rufescent, epipleura yellow. Punctures on head and pronotum very remote and fine, alutaceous microsculpture of the upper surface consisting of nearly round meshes, which are a little less impressed and slightly elongate on the disc of elytra. The latter with transverse striolae and 4 longitudinal striae laterally, the inner ones being nearly totally obliterated. Sides of elytra with a feeble impression in the posthumeral portion, at least in the ♀. Apex of elytra bitruncate, median angle spinous, sutural and exterior angles forming sharp points. Anterior tibiae not very strongly broadened in the ♂, exterior apical angle sharp, slightly produced. Anterior tarsi subparallel in the ♀, broadly oval in the ♂. The type, which served the author for his short but striking description, was collected in North Australia near Port Essington. Régimbart (1907, *l.c.*) based his supplementary diagnosis on specimens from Adelaide River, communicated to him by the British Museum. Through the courtesy of the latter I received a female specimen of this series for my collection, from which I took the above-mentioned characters. The male characters are drawn from Régimbart's description. *M. gouldi* resembles very much *M. darlingtoni*, having nearly the same size and features of the body, and bearing also a yellow side margin; it is, however, distinguished at once by the presence of a spine in the middle of truncature.

Subg. 3. **Australogyrus**, nov.

Size 11 to 16 mm. Elongate-oval, moderately convex, upper surface rather flat. Longitudinal striae in elytra not abbreviated, only 1 or 2 obliterated near the suture, outer 3–4 canaliculate, the corresponding interstices in form of narrow ribs. Inner portion of truncature more or less deeply concave, outer portion nearly straight, oblique; sutural angle strongly dehiscent and broadly rounded, median angle also rounded, outer angle pointed. Anterior legs in most of the male specimens extremely elongated, sometimes longer than the body; in this case the tibiae, which are very slender basally and broadened only in about the apical third, are strongly curved inwards, the femora are equally curved in inverse sense, having a deep channel on the anterior side, the borders of which are strongly serrulate. Anterior tarsi of ♂ basally about as wide as the apex of tibiae, gradually narrowing towards the apex; under surface of apical joint partially smooth, first joint with a particular area of large round suckers. Aedeagus shorter than the lateral lobes, rather subparallel, tip rounded; lateral lobes strongly curved in apical half.

There are only 3 species in this subgenus, which is apparently confined to the Australian continent.

Key to Species and Subspecies.

1. Only 1 longitudinal stria near the suture of elytra obliterated; 3 outer striae canaliculate 2
2. Upper surface chiefly olive-coloured, longitudinal striae on elytra greenish, well marked 3
3. The 6th interstice on elytra anteriorly about half as wide as the interstices 3-5, more than twice as wide as interstices 7 and 8 4
4. Length 12·5 to 14 mm. Oblong-oval, rather broad .... *M. oblongus oblongus* Boisd.
4′. Length 11 to 13 mm. Body narrower and more parallel ..... *M. oblongus opacior* Blackb.
3′. The 6th interstice on elytra much narrower than the interstices 3-5, scarcely wider than 7 and 8 .... *M. oblongus latior* Clark.
2′. Upper surface chiefly brownish in colour, inner striae on elytra only superficially marked, the outer ones coppery .... *M. rivularis* Clark.
1′. Two longitudinal striae near the suture of elytra obliterated; 4 outer striae canaliculate *M. viridisulcatus* Mjöb.

Macrogyrus (Australogyrus) oblongus oblongus (Boisd.).

Gyrinus oblongus Boisd. 1835, Fn. Ent. Océan Pacif., Voy. Astrolabe, 2, 52.

Enhydrus oblongus Aubé, 1838, Spec. Col., 6, 653; (?) Lacord., 1854, Hist. Nat. Ins., 1, 438; (?) Redtenb., 1868, Reise Novara, Zool. 2, I A, 1, 23.

Macrogyrus rivularis Rég., 1882, Ann. Soc. Ent. France, (6) 2, 450, pl. 12, f. 61; Rég., 1883, Ann. Soc. Ent. France, (6) 3, 123, pl. 6, f. 67; Rég., 1884, Ann. Soc. Ent. France, (6) 3, (1883), 471.

(?) *Enhydrus oblongus* Masters, 1885, Proc. Linn. Soc. N. S. Wales, 10, 597.

Macrogyrus oblongus Rég., 1892, Ann. Soc. Ent. France, 60, (1891), 671, 741 (partim); (?) Masters, 1896, Proc. Linn. Soc. N. S. Wales, 21, 698 (partim); Rég., 1907, Ann. Soc. Ent. France, 76, 139.

Macrogyrus canaliculatus Froggatt, 1907, Aust. Ins., p. 135.

Macrogyrus oblongus Ahlw., 1910, Col. Cat., 21, 11 (partim); Zimmerm., 1917, Ent. Mitt., 6, 142; Ochs, 1924, Ent. Bl., 20, 238 (partim); Ochs, 1934, Mitt. Schweiz. Ent. Ges., 16, 100.

Size 12·5–14 mm. Elongate-oval, moderately convex, flattened above. Upper surface chiefly olive-coloured, with bluish, in certain places on head and pronotum also coppery or violet reflections; elytral striae greenish. Under surface dark-brown to black, natatorial and sometimes anterior legs rufescent. Upper surface with a strong alutaceous sculpture, consisting chiefly of nearly round meshes, which become slightly transverse in some places. The front is wrinkled, and there exists moreover a fine puncturation on the upper surface, very dense on the labrum and diminishing gradually backwards. Interstices of elytra with oblique, curved scratches. First longitudinal stria near the suture of elytra nearly completely obliterated, striae 2–4 very narrow, 5 a little wider at least basally, 6–8 channelled. Interstices 1 and 2 united by the want of first stria and therefore twice as wide as interstices 3–5, which are nearly equal in width, interstice 6 only half as wide as the latter or a little larger, 7–9 are narrow ribs at least at basal half. Side margin of elytra strongly enlarged behind the humeral portion, still more strongly so in large male specimens, and having in the latter a little swelling in the place where the knee of anterior legs is inserted beneath; tip of side margin pointed. Middle and sutural angle of truncature rounded, concavity of inner portion moderate. Anterior margin of anterior tibiae obliquely truncate in both sexes, outer apical angle obtuse, a little more rounded in ♂. Aedeagus of the latter rufescent, subparallel, basally a little wider, sometimes attenuated in middle of length, basal third channelled, apical portion carinate, tip truncate with rounded angles. Lateral lobes infuscate, except at base and apex, strongly enlarged and curved inwards apically; tip obliquely truncate, interior apical angle acute, exterior angle rounded.

Widely distributed in eastern Australia and apparently a rather common and also very variable insect. The type specimen from the ancient collection of Dejean, now belonging to Mr. Oberthür, is labelled "Nova Hollandia", without further exact indication of locality. It was studied by Régimbart (*l.c.*, 1891, 671) and said to be equal to specimens from Sydney, from which I have drawn the above description. Specimens from the following localities are of the same kind:

N. S. Wales: Sydney (Harv. Exp., Darlington, Mus. Cambridge, Mass.), (Lea, Macleay Mus.), and (Staudinger vend.); Parramatta (Mus. Pretoria, Coll. Ochs, Staudinger vend.); Cooma (Handschin, Mus. Basel); Hornsby, 21.8.31 (Harv. Exp., Darlington, Mus. Cambridge, Mass.); Jannali, near Sydney (id.); Pipers Flats (Macleay Mus.); Hunter River (ibid.); Gosford (F. A. A. Skuse, Aust. Mus.); Upp. Chichester Riv., Blue Gum Knob, 28.9.21 (A. Musgrave, Aust. Mus.); Salisbury, 1,050 ft., 12–15.2.32 (Harv. Exp., Darlington, Mus. Cambridge, Mass.); National Park, 22.8.32 (id.); Blue Mts., Megalong Valley, 1,000 ft., 18.1.32 (id.); Blackheath, 3,000 ft., 21.1.32 (id.); Mt. Wilson, 3,500 ft., I.1932 (id.); The Dorrigo, 3,000 ft., 17.2.32 (id.).

S. Queensland: Nat. Park, McPherson Range, 3–4,000 ft., III.1932 (id.).

Macrogyrus (Australogyrus) oblongus latior (Clark).

Macrogyrus opacior Blackburn, 1901, Trans. Roy. Soc. S. Aust., 25, 127; Rég., 1907, Ann. Soc. Ent. France, 76, 159; Ahlw., 1910, Col. Cat., 21, 11.

Specimens in several small series seen, collected in Victoria, are smaller in size, measuring but 11–12, exceptionally up to 13 mm. in length. Side margin of elytra less broadened behind the humeral portion, wherefrom results a more parallel and relatively more elongate form of the body. In the ♀ the anterior margin of anterior tibiae is nearly straightly truncate, outer apical angle acute.

These main characters agree very well with those indicated by the Rev. Thomas Blackburn for his *M. opacior*, except colour and sculpture, in which the specimens before me do not differ from the nominal form, which they equal also in all other characters. Apparently the type of Blackburn was a rufinotic dull specimen, such specimens being often subject to some alteration in sculpture, for which reason these characters—opaque reddish-brown elytra, lack of striae between the sulci and the suture, substitution of scratches by elevated lines—are of minor importance. In the larger males of this subspecies the anterior legs are also elongated and curved. A small ♂, measuring only about 11 mm., has very short anterior legs with nearly straight tibiae; the latter have but a very short basal attenuation and are gradually and rather strongly widened towards the apex, which is obliquely truncate as a rule, but with the exterior angle more acute, thus approaching the feature in ♀. In *oblongus oblongus* the anterior tibiae of small males are less different from those of large males with elongate legs.

The specimens which I refer to *M. opacior* Blackb. are labelled "Victoria" and belong to the collections of the American Museum (Edw. Coll.), Mus. Cambridge, Mass., Mus. Berlin, and Mus. Hamburg (Melbourne). The type of Blackburn came from Mt. Macedon, collected by Kershaw. The British Museum has a small ♂ from S. Australia (Bakewell), which belongs probably also to *oblongus opacior*.

Macrogyrus (Australogyrus) oblongus latior (Clark).

Enhydrus latior Clark, 1864, J. Ent., 2, 217.

(?) *Enhydrus oblongus* Macleay, 1873, Trans. Ent. Soc. N. S. Wales, 2, 128.

Enhydrus latior Rég., 1882, Ann. Soc. Ent. France, (6) 2, 455.

Macrogyrus latior Rég., 1884, Ann. Soc. Ent. France, (6) 3, (1883), 472.

Enhydrus latior Masters, 1885, Proc. Linn. Soc. N. S. Wales, 10, 597.

Macrogyrus latior Séverin, 1889, Ann. Soc. Ent. Belg., 33, 157.

Macrogyrus oblongus Rég., 1892, Ann. Soc. Ent. France, 60, (1891), 671, 741 (partim); Rég., 1907, Ann. Soc. Ent. France, 76, 139 (partim); Ahlw., 1910, Col. Cat., 21, 11 (partim).

Macrogyrus rivularis Mjöb., 1916, Ark. Zool., 10, 10 (partim).

Macrogyrus oblongus Ochs, 1924, Ent. Bl., 20, 238 (partim).

(?) *Macrogyrus latior* Tillyard, 1926, Ins. Austral. N. Zeal., p. 193, pl. 17, fig. 16.

There exists in Queensland a third varietal form of this species, which, resembling in all other characters the nominal form, is distinguished from the latter by the sixth interstice on elytra being anteriorly much narrower than interstices 3–5 and hardly wider than ribs 7 and 8.

Clark's types came from Moreton Bay. The Zoolog. Museum of the Univ. of Berlin has a topotype and I have seen specimens from Brisbane (Queensland Mus.); Blackall Range, 13.4.1911 (Wild, ibid.); Mt. Tambourine (Pottinger, XII, 1919, Hacker, ibid.); Blackall Range and Glen Lamington (Mjöberg, Mus. Stockholm); Mackay (D. S. North, Brit. Mus.).

Rev. Clark, who at first found out the specific difference between his *M. rivularis* and what we name now *M. oblongus*, wished doubtless to establish the latter species by *Enhydrus latior*, his *oblongus* cited at the end of his publication being identical with *M. australis* Brullé. Although in the remarks he adjoins to his description there are mentioned some characters which do not prove right (apex of elytra more deeply emarginate than in *M. rivularis*, sutural angle not dehiscent), his specimens from Moreton Bay must have been identical with the subspecies I characterize above, and I prefer to retain the name established by Clark instead of creating a new name and ranging that of Clark among the synonyms of *M. oblongus*.

South of Brisbane the nominal form and ssp. *latior* do apparently overlap, the specimens from MacPherson Range belonging to the former, those from Mt. Tambourine to the latter. Specimens from Murrurundi (Macleay Mus.) and Bunya Mts., 3,500 ft., 26.2.32 (Harv. Univ. Exp., Mus. Cambridge, Mass.) must still be studied to determine whether they belong to *oblongus oblongus* or to ssp. *latior*.

Macrogyrus (Australogyrus) rivularis (Clark).

Enhydrus rivularis Clark, 1864, J. Ent., 2, 218.
Macrogyrus longipes Rég., 1882, Ann. Soc. Ent. France, (6) 2, 452; Rég., 1884, Ann. Soc. Ent. France, (6) 3, (1883), 471.
Enhydrus rivularis Masters, 1885, Proc. Linn. Soc. N. S. Wales, 10, 597.
Macrogyrus longipes Masters, 1885, Proc. Linn. Soc. N. S. Wales, 10, 598; Séverin, 1889, Ann. Soc. Ent. Belg., 33, 157.
Macrogyrus rivularis Séverin, 1889, Ann. Soc. Ent. Belg., 33, 158.
Macrogyrus oblongus var. *rivularis* Rég., 1892, Ann. Soc. Ent. France, 60, (1891), 671, 741.
Macrogyrus oblongus var. *longipes* Rég., 1892, Ann. Soc. Ent. France, 60, (1891), 671, 741.
Macrogyrus rivularis Masters, 1896, Proc. Linn. Soc. N. S. Wales, 21, 698.
Macrogyrus oblongus var. *rivularis* Rég., 1907, Ann. Soc. Ent. France, 76, 139.
Macrogyrus oblongus var. *longipes* Rég., 1907, Ann. Soc. Ent. France, 76, 139.
Macrogyrus oblongus var. *rivularis* Ahlw., 1910, Col. Cat., 21, 11.
Macrogyrus oblongus var. *longipes* Ahlw., 1910, Col. Cat., 21, 11.
Macrogyrus oblongus var. *rivularis* Zimm., 1917, Ent. Mitt., 6, 142.

Size 12 to 16 mm. Very similar to the preceding in general appearance, on the average a little larger in size, females evidently more elongate. Upper surface chiefly brownish coloured, outer sulci on elytra coppery. Inner striae on the latter narrow and but superficially marked, interstices of the latter even. Inner portion of truncature strongly concave, sutural angles very dehiscent. Anterior margin of anterior tibiae less oblique in ♂, nearly horizontal in ♀, exterior apical angle in the latter nearly rectangular. Aedeagus ♂ broader than in *M. oblongus*, basal channel on upper surface very short, longitudinal keel relatively longer.

Through the kindness of the British Museum I possess one of Clark's paratypes, which came from Victoria. Further specimens seen: Victoria, without exact indication of locality (Mus. Berlin, very large examples); Lorne (Mus. Budapest); Ferntree Gully, 9.3.1918 (Pottinger Coll., Queensl. Mus.); N. S. Wales, Mt. Kosciusko, 5–7,000 ft., XII, 1931 (Harv. Univ. Exp., Darlington, Mus. Cambridge, Mass.). There is no doubt that *M. rivularis* is a distinct species, as clearly seen by Clark, and not a varietal form of *M. oblongus*, as believed by Régimbart and later authors.

Macrogyrus (Australogyrus) viridisulcatus Mjöberg.

Macrogyrus viridisulcatus Mjöberg, 1916, Ark. Zool., 10, 10, fig. 9.

Size 13 to 14 mm. Elongate-oval, somewhat attenuated to both ends, a little more convex than the allied species. Upper surface more richly coloured; under surface black, apical margin of abdominal segments and legs rufescent. On the elytra 2 longitudinal striae near the suture nearly completely obliterated, striae 3 and 4 broad and strongly impressed, green or coppery, 5–8 channelled. Interstices 1–3 united by the want of striae 1 and 2 and therefore very broad, interstices 4 and 5 narrower than usual on account of the broad striae 3 and 4, interstices 6–9 narrow ribs. Inner portion of truncature but slightly concave. Anterior margin of anterior tibiae slightly obliquely truncate in both sexes, outer angle rounded. Males with elongated anterior legs, aedeagus rufescent, narrower than in *M. oblongus*, also its basal channel, keel more elevated; lateral lobes less infuscate, apex nearly horizontally truncate.

Mjöberg based his description of this well-distinguished species on specimens he had collected at Malanda, Evelyne and Cedar Creek in North Queensland, now in the Stockholm Museum. A series of the same kind was taken by Mr. Darlington in Atherton Tableland: Millaa-Millaa, 2,500 ft., April, 1932 (Harv. Univ. Exp., Mus. Cambridge, Mass.).

Subg. 4. **Clarkogyrus**, nov.

Size 10–12 mm. Elongate-oval, moderately convex. Longitudinal striae in elytra not abbreviated, the first near the suture apparently always nearly totally obliterated, the following generally well marked, outer 2 or 3 larger and more deeply impressed, corresponding interstices narrower and more convex. Truncature convex, only 1 point at the end of the side margin of elytra. Anterior legs of ♂ not elongated.

Macrogyrus (Clarkogyrus) reichei (Aubé).

Enhydrus reichei Aubé, 1838, Spec. Col., 6, 654; Lacord., 1854, Hist. Nat. Ins., 1, 438.
Enhydrus reichii Clark, 1864, J. Ent., 2, 216.
Enhydrus assimilis Clark, 1864, J. Ent., 2, 217.
Macrogyrus reichei Rég., 1882, Ann. Soc. Ent. France, (6) 2, 453, pl. 12, fig. 62, 62a, 62b.
Enhydrus assimilis Rég., 1882, Ann. Soc. Ent. France, (6) 2, 455.
Macrogyrus reichei Rég., 1884, Ann. Soc. Ent. France, (6) 3, (1883), 471.
Macrogyrus assimilis Rég., 1884, Ann. Soc. Ent. France, (6) 3, (1883), 472.
Enhydrus reichei Mast., 1885, Proc. Linn. Soc. N. S. Wales, 10, 597.
Enhydrus assimilis Mast., 1885, Proc. Linn. Soc. N. S. Wales, 10, 597.
Macrogyrus reichei Sév., 1889, Ann. Soc. Ent. Belg., 33, 158.
Macrogyrus assimilis Sév., 1889, Ann. Soc. Ent. Belg., 33, 157.
Macrogyrus reichei Rég., 1892, Ann. Soc. Ent. France, 60, (1891), 671, 741; Masters, 1896, Proc. Linn. Soc. N. S. Wales, 21, 698; Rég., 1907, Ann. Soc. Ent. France, 76, 139; Ahlw., 1910, Col. Cat., 21, 11; Mjöb., 1916, Ark. Zool., 10, 9; Zimmerm., 1917, Ent. Mitt., 6, 142.
Macrogyrus latior Tillyard, 1926, Ins. Austral. N. Zeal., p. 194, pl. 17, fig. 16.

M. reichei which is the unique species to represent the subgenus *Clarkogyrus*, resembles very much *M. oblongus* ssp. *opacior* in general aspect, having also nearly the same size, but may be distinguished at once by the convex and not sinuate truncature of elytra. Moreover, the body is a little more attenuated anteriorly in *M. reichei* and the broadest portion approaches the apex; the lateral margins of prothorax and elytra are not absolutely in the same line, and a very slight angle is formed by their conjunction. Upper surface chiefly olive-coloured with blue or violet reflections; under side metallic black, epipleura, last abdominal segments and legs mostly rufescent. Microsculpture as in *M. oblongus*, transverse striolae not curved and less evident. Longitudinal stria 1 in elytra nearly completely obliterated, 2–5 narrow, generally well marked, 6–8 wider, channelled, 6th at least basally. Interstices 1 and 2 united by the want of stria 1 and therefore twice as wide as interstices 3–6, which are nearly equal in width, 7–9 generally narrower and more convex. Anterior tibiae shortly curved inwards basally, gradually and rather strongly broadened towards the apex, evidently more so in ♂; apical margin nearly horizontally truncate in ♀, exterior angle more or less rounded, very obliquely truncate in ♂, exterior angle obtuse. Anterior tarsi of ♂ as in *Australogyrus*, but a little narrower. Aedeagus very broad, nearly twice as wide as the lateral lobes, shorter than the latter, which are strongly curved inwards.

The type used by Aubé for his description (ex Coll. Reiche, received by Hoffman) was without indication of locality, but is said by Lacordaire (*l.c.*, 1854) to come from Australia, where the insect has been captured meantime in South Australia, Victoria and New South Wales. I have never seen large series of this species, and most of the specimens were inprecisely labelled; the few exact localities given are the following:

South Australia: Adelaide (Brit. Mus., Mus. Berlin and Halle).

Victoria: Eltham, 2.2.18 (Pottinger, Queensl. Mus.).

N. S. Wales: Oberon (F. H. Taylor, Austral. Mus.); Jindabyne, 3,000 ft., III/1889 (Helms, Austral. Mus.); Blue Mts., Megalong Valley, 1,000 ft., 18.1.32 (Darlington, Mus. Cambridge, Mass.).

Apparently this species is subject to variation in a high degree. Some of the specimens are highly flattened above, others more convex. There are specimens with the upper surface very shining, and those in which the colour changes to blue; sometimes the rufescent parts of the under side are more or less darkened. The longitudinal striae on elytra are more strongly impressed in certain examples and the corresponding interstices more convex in this case; also the transverse striolae may be more or less evident. From similar differences Clark derived his *Enhydrus assimilis*, which in my opinion cannot be regarded as a valid species.

(Subg. 5. **Ballogyrus**, nov.)

Not represented in Australia. Characterized by the nearly complete lack of longitudinal striae on elytra and the apical points very obtuse. Based on *M. leopoldi* Ball, 1932 (Mém. Mus. Roy. Hist. Nat. Belg., 4, 4, p. 21, pl. 1, figs. 3 and 4). The insect, shown by the figure, has much affinity in general aspect to *M. striolatus*, which is, however, much larger in size and distinguished by the lateral portion of metasternum forming a large triangle, which is narrow and elongate in *Ballogyrus*.

(Subg. 6. **Cyclomimus** Ochs.)

Cyclomimus Ochs, 1929, Ent. Bl., 25, 199.

Also not represented in Australia. The species belonging to this subgenus are the most irregular of the genus. They are remarkable by the total want of striolae on elytra, the longitudinal striae being reduced to nearly obliterated fine lines. The general aspect is *Dineutus*-like; they are, however, true *Macrogyrus* by the presence of scutellum, the feature of anterior legs and of the lateral portion of metasternum, which is narrow and elongate in *Cyclomimus*, always in form of a large triangle in *Dineutus*.

Subg. 7. **Tribologyrus**, nov.

Size 8 to 17 mm., most of the species not exceeding 12 mm. in length. Elongate to broadly oval, more or less convex. Longitudinal striae on elytra varying in number from 3 to 8, being more or less impressed and sometimes strongly abbreviated. Apex of elytra bitruncate, with 3 generally well-marked points or spines.

This subgenus comprises the majority of species of the genus, which may be rather different in general aspect, but have as common characters the large outer portion of metasternum and the bitruncate apex of elytra. Represented in Australia only by 4 species, most of which belong to the smallest and less developed of the subgenus.

Key to Australian Species.

1. Microsculpture on the disc of elytra consisting of rather strongly impressed round or slightly elongate meshes.
2. Body oval or moderately elongate, twice as long as wide at the most 3
3. Elytra with 7 longitudinal striae, the inner ones mostly faint, but perceptible at least posteriorly .... *M. australis* Brullé
3′. Elytra with only 4 longitudinal striae, the inner ones nearly completely obliterated ... 4
4. Larger (9 to 10·25 mm.), somewhat elongate, apical points scarcely produced *M. finschi* Ochs
4′. Smaller (8·5 to 9·25 mm.), regularly oval, apical points more evident generally *M. finschi* ssp. *minor*, nov.
2′. Body very elongate, more than twice as long as wide 5
5. Upper surface black, with a feeble metallic hue .... *M. angustatus* Rég.
5′. Upper surface brassy .... *M. angustatus* ssp. *metallescens*, nov
1′. Microsculpture on the disc of elytra consisting of fine, very elongate meshes *M. elongatus* ssp. *laevis* Ochs

Macrogyrus (Tribologyrus) australis (Brullé).

Enhydrus australis Brullé, 1835, Hist. Nat. Ins., 5, II, p. 237, pl. 10, fig. 2.
Enhydrus oblongus Clark, 1864, J. Ent., 2, 219.
? *Enhydrus oblongus* Macleay, 1873, Trans. Ent. Soc. N. S. Wales, 2, 128.
Macrogyrus oblongus Rég., 1882, Ann. Soc. Ent. France, (6) 2, 449.
Macrogyrus canaliculatus Rég., 1882, Ann. Soc. Ent. France, (6) 2, 450.
Macrogyrus simoni Rég., 1882, Ann. Soc. Ent. France, (6) 2, 447, pl. 12, f. 60.
Macrogyrus oblongus Rég., 1884, Ann. Soc. Ent. France, (6) 3, (1883), 471.
Macrogyrus canaliculatus Rég., 1884, Ann. Soc. Ent. France, (6) 3, (1883), 471.
Macrogyrus simoni Rég., 1884, Ann. Soc. Ent. France, (6) 3, (1883), 471.
? *Enhydrus oblongus* Masters, 1885, Proc. Linn. Soc. N. S. Wales, 10, 597.
Macrogyrus canaliculatus Masters, 1885, Proc. Linn. Soc. N. S. Wales, 10, 598.
Macrogyrus simoni Masters, 1885, Proc. Linn. Soc. N. S. Wales, 10, 598.
Macrogyrus oblongus Sév., 1889, Ann. Soc. Ent. Belg., 33, 158.
Macrogyrus canaliculatus Sév., 1889, Ann. Soc. Ent. Belg., 33, 157.
Macrogyrus simoni Sév., 1889, Ann. Soc. Ent. Belg., 33, 158.
Macrogyrus australis Rég., 1892, Ann. Soc. Ent. France, 60, (1891), 670, 741.
Macrogyrus australis var. *canaliculatus* Rég., 1892, Ann. Soc. Ent. France, 60, (1891), 670, 741.
Macrogyrus simoni Rég., 1892, Ann. Soc. Ent. France, 60, (1891), 741.
? *Macrogyrus oblongus* Frogg., 1907, Austral. Ins., p. 135.
Macrogyrus australis Rég., 1907, Ann. Soc. Ent. France, 76, 139.
Macrogyrus australis var. *canaliculatus* Rég., 1907, Ann. Soc. Ent. France, 76, 139.
Macrogyrus simoni Rég., 1907, Ann. Soc. Ent. France, 76, 139.
Macrogyrus australis Ahlw., 1910, Col. Cat., 21, 10.
Macrogyrus australis var. *canaliculatus* Ahlw., 1910, Col. Cat., 21, 10.
Macrogyrus simoni Ahlw., 1910, Col. Cat., 21, 11.
Macrogyrus australis Mjöb., 1916, Ark. Zool., 10, 9.
Macrogyrus simoni Mjöb., 1916, Ark. Zool., 10, 9.
Macrogyrus oblongus Mjöb., 1916, Ark. Zool., 10, 9, 10.
Macrogyrus australis Zimmerm., 1917, Ent. Mitt., 6, 141; Ochs, 1924, Ent. Bl., 20, 238.
Macrogyrus simoni ? Ochs, 1924, Ent. Bl., 20, 238.

Size 9·5 to 11·5 mm. Oval, somewhat elongate, moderately convex. Upper surface shining on the disc, olive-coloured, with varicoloured reflections, especially on the head and on the sides of pronotum, longitudinal striae on elytra green or coppery; under side dark brown, epipleura, abdomen and legs rufescent. Upper surface with an alutaceous sculpture consisting of nearly round meshes, labrum and sides of the head punctate, elytra with fine transverse striolae and 7 longitudinal striae (the first near the suture being completely obliterated). The inner ones of the latter (1–3) more or less faint,

but perceptible at least posteriorly, 4 and 5 narrow, 4 mostly strongly abbreviated, 6 about twice as wide as 5, 7 about twice as wide as 6 and bifid behind; interstices more or less convex, especially exteriorly. Apex of elytra bitruncate, 3-pointed. Anterior tibiae short, in ♂ strongly broadened from base to apex, exterior apical angle sharp, slightly produced; anterior tarsi elongate-oval and relatively slightly attenuated towards the apex in ♂, subparallel in ♀. Aedeagus nearly as long as the lateral lobes, rather broad subparallel, gradually narrowed in apical third, tip rounded.

The type is labelled "Iles de l'Océanie"; its origin is therefore uncertain. The species seems to be rather common and widely spread in Australia. The following records came to my knowledge:

S. Australia: Port Lincoln (Blackb., 1884, Brit. Mus.); Adelaide (div. collectors, Mus. Dahlem., Berlin, Halle, London).

Victoria: Melton, 15.9.1918 (Pottinger, Queensl. Mus.).

N. S. Wales: Sydney (div. collectors, div. Mus.); Parramatta (Mus. Pretoria); Clarence River (Macleay Mus.); Tamworth (Lea, coll. Guignot).

Queensland: Brisbane (div. collectors, div. Mus.); Moreton Bay (Brit. Mus.); Ipswich (Aust. Mus.); Pine River (Darlington, Mus. Cambridge, Mass.); Burnett River (Aust. Mus.); Rockhampton (Macleay Mus.); Blackall Range, 13–23.4.1911 (Wild, Queensl. Mus.); Townsville (Janson vend., coll. Ochs); Atherton (Mjöberg, Mus. Stockholm); Evelyne (Mjöberg, Mus. Stockholm); Cairns (E. Allen, Queensl. Mus.); Atherton Tableland, L. Barrine, 2,300 ft., April, 1932 (Darlington, Mus. Cambridge, Mass.); Atherton Tableland, Millaa-Millaa, 2,500 ft., April, 1932 (id.).

This species was subject to many misinterpretations, but I think its synonymy as given above will prove right. *M. simoni* is said by its author to have the anterior tarsi 1½ times as long as the tibiae, which is certainly erroneous; all other characters indicated do not differ from those of *M. australis*, inasmuch as there is a certain degree of variability in the latter, concerning form and convexity of the body, apical points which may be more or less acute, and the longitudinal striae on elytra. *M. canaliculatus* Rég. is based on examples in which the longitudinal striae on elytra are more evident, which is, however, an individual and not a racial character, as there are in the same series specimens which might pass as *canaliculatus* as well as belonging to the nominal form. *M. canaliculatus* and *M. simoni* are therefore, in my opinion, simple synonyms of *M. australis*.

Macrogyrus (Tribologyrus) angustatus Rég.

Macrogyrus angustatus Rég., 1882, Ann. Soc. Ent. France, (6) 2, 448; Rég., 1884, Ann. Soc. Ent. France, (6) 3, 471; Masters, 1885, Proc. Linn. Soc. N. S. Wales, 10, 598; Sév., 1889, Ann. Soc. Ent. Belg., 33, 157; Rég., 1892, Ann. Soc. Ent. France, 60, (1891), 741; Rég., 1907, Ann. Soc. Ent. France, 76, 139; Rég., 1908, in Michaelson and Hartmayer, Fn. S.W. Aust., 1, 8, p. 314; Ahlw., 1910, Col. Cat., 21, 10; Mjöb., 1916, Ark. Zool., 10, 9; Zimm., 1920, Ent. Bl., 16, 232.

Size 9 to 10·5 mm. Smaller than the former, body more elongate, upper surface darker coloured, black with a feeble metallic hue. **Elytra with 8 longitudinal striae: 1–5 very faint, but more or less perceptible (also the first near the suture, which is totally obliterated in *M. australis*), 6 narrow, especially behind, 7 a little broader and better perceptible behind, 8 very broad and bifid behind; interstices scarcely convex, also exteriorly. Horizontal part of truncature generally less concave than in *M. australis*, apical points less prominent, especially the exterior one. Anterior tibiae still shorter than in the latter, anterior tarsi of male more attenuated towards the apex. Aedeagus narrower, subparallel, scarcely narrowed only in apical fourth, tip more broadly rounded.**

This diagnosis is suitable for Western Australian specimens. Type locality: King George's Sound. Further records are: Salt River (Aust. Mus., Macleay Mus.); Pemberton, Oct., 1931 (Darlington, Harv. Exp., Mus. Cambridge, Mass.); Bridgetown, 8.11.1931 (id.); Margaret River, Oct., 1931 (id.); Boranup, 1–3 Aug., 1905 (Hamb. S.W. Austral. Exp., Stat. 146); Murray R., 23 Sept., 1905 (id., Stat. 134); Serpentine River, 23–25.9.1905 (id., Stat. 132); Jarrahdale, 20 Sept., 1905 (id., Stat. 129); Pinjarrah, Fairbridge Farm, 1 Oct., 1931 (D. C. Swan), from still pools and sides of a running stream; Perth (Hardy, Aust. Mus.); Perth, Darlington, 14 Dec., 1912 (Hardy, Aust. Mus.); Perth, Darling Range, 18 Oct., 1931 (Darlington, Harv. Exp., Mus. Cambridge, Mass.); Mundaring Weir, 22 Nov., 1931 (id.); Geraldton, Oct., 1931 (id.). Régimbart (*l.c.*, 1882, 1884) cites the species from Cape York, which is certainly erroneous.

M. angustatus metallescens, nov.

Macrogyrus angustatus Rég., 1892, Ann. Soc. Ent. France, 60, (1891), 670.

Régimbart (*l.c.*, 1891) records the species as captured in N. S. Wales: Paroo and Darling River, and indeed I met in the collections revised a small number of specimens from S.E. Australian localities. As already mentioned by Régimbart, these examples are evidently brass-coloured above, but those studied by me are by no means smaller than those from Western Australia, reaching even 11 mm. in length. Moreover, in the ♂ the anterior tibiae are a little more robust than in the nominal form and the anterior tarsi are more broadly oval and less narrowed towards the apex, nearly as in *M. australis*. The aedeagus is a little narrower than in the nominal form, but of similar shape.

Type, 1 ♂ from Victoria, Bowen, from the ancient collection Godeffroy, formerly received by the Hamburg Museum. The Zoological Museum of the University of Berlin possesses a small series labelled N. S. Wales, and the Entomologisches Institut at Dahlem has some examples from Adelaide from the ancient collection of C. Schaufuss.

Macrogyrus (Tribologyrus) finschi Ochs.

Macrogyrus finschi Ochs, 1925, Senckenbergiana, 7, 174.

Size 9 to 10·25 mm. Also very similar to *M. australis*, but a little smaller on the average and somewhat darker coloured above. Meshes of alutaceous sculpture on the disc of elytra slightly elongate. Longitudinal striae nearly entirely obliterated interiorly, only 4 external striae present: 1 very narrow and generally obliterated in apical half, 2 a little broader and better perceptible behind, 3 about twice as large as 2, 4 at least twice as large as 3 and bifid behind. Truncature and anterior tibiae nearly as in *M. australis*; anterior tarsi of ♂ more attenuated towards the apex, aedeagus a little broader, tip more acute.

Type Locality.—Torres Strait, Morilug (Dr. O. Finsch, Zool. Museum of the University of Berlin and my collection).

M. finschi minor, nov.

Captured also on the mainland in Cape York Peninsula. These specimens are smaller in size (8·50 to 9·25 mm.) and of less elongate and more regular oval form of the body. Moreover the apical points of truncature are generally more prominent.

Type Locality.—Cape York Peninsula, McIlwraith Range, Lankelly Creek, June, 1932 (Darlington, Harv. Exp., Mus. Cambridge, Mass., and in my collection). Further records: Coen, May, 1932 (Darlington, Harv. Exp. Mus. Cambridge, Mass.); Endeavour River (Macleay Mus.).

Macrogyrus (Tribologyrus) elongatus laevis Ochs.

Macrogyrus elongatus Rég., 1882, Ann. Soc. Ent. France, (6) 2, 447 (partim).

Macrogyrus elongatulus Masters, 1885, Proc. Linn. Soc. N. S. Wales, 10, 598.

Macrogyrus elongatus Sév., 1889, Ann. Soc. Ent. Belg., 33, 157 (partim); Rég., 1892, Ann. Soc. Ent. France, 60, (1891), 670 (partim); Mjöb., 1916, Ark. Zool., 10, 9; Ahlw., 1910, Col. Cat., 21, 10 (partim); Ochs, 1925, Senckenbergiana, 7, 175 (partim).

Macrogyrus elongatus ssp. *laevis* Ochs, 1929, Ent. Bl., 25, 198.

Size 9 to 10 mm. Oval, somewhat elongate, strongly attenuated to both ends; rather convex, somewhat gibbous in the scutellar region. Upper surface very shining, black, with a brassy hue and varicoloured reflections, especially on the head and on the sides of pronotum, longitudinal striae on elytra coppery; under side rufescent, medially somewhat darker. Alutaceous sculpture of upper surface consisting of strong, nearly round meshes only on the labrum and clypeus and on the sides of the head, pronotum and elytra; on the disc of the latter the meshes are very fine and exceedingly elongate. Elytra with fine transverse striolae and 3 longitudinal striae laterally; side margin very broad, apex of elytra bitruncate, outer and median angle spinous, sutural angle pointed. Anterior tibiae of ♂ short, regularly broadened from base to apex, which is nearly horizontally truncate, exterior angle nearly rectangular; anterior tarsi moderately broadened and strongly attenuated towards the apex. Aedeagus shorter than the lateral lobes, gradually narrowed from base to apex, tip rounded.

Type Locality.—N. Queensland, Temple Bay, Olive River (G. H. Wilkens. 1923, British Museum). Further records: Australia (Coll. Wehncke and Mus. Stettin); Cape York (Coll. Régimbart and Mus. Berlin, Daemel coll.); Claudie River, Jan., 1914 (T. A. K., Mus. Cambridge, Mass.); McIlwraith Range, Rocky Scrub and Lankelly Creek, June, 1932 (Darlington, Mus. Cambridge, Mass.).

Subg. 8. **Macrogyrus**, s. str., 1945, J. Balf.-Browne.

Body very elongate, only 2 longitudinal striae on elytra laterally, truncature of elytra convex, not bitruncate, sutural angle rounded, exterior angle obtuse, scarcely marked.

This subgenus, which is founded upon a single species occurring in S.E. Australia and Tasmania, is very similar to certain species of the genus *Andogyrus* which inhabit the Andes of South America, thus intimating ancient relations between the fauna of the latter continent and that of Australia. *Macrogyrus*, however, differs by the presence of transverse striolae on elytra, which are wanting in *Andogyrus*.

Macrogyrus (s. str.) **howitti** (Clark).

Enhydrus howittii Clark, 1864, J. Ent., 2, 215.

Macrogyrus howitti Rég., 1882, Ann. Soc. Ent. France, (6) 2, 440, pl. 12, fig. 56; Rég., 1884, Ann. Soc. Ent. France, (6) 3, 471.

Enhydrus howittii Masters, 1885, Proc. Linn. Soc. N. S. Wales, 10, 597.

Macrogyrus howitti Sév., 1889, Ann. Soc. Ent. Belg., 33, 157; Rég., 1892, Ann. Soc. France, 60, (1891), 740; Rég., 1907, Ann. Soc. Ent. France, 76, 139; Ahlw., 1910, Col. Cat., 21, 10; Mjöb., 1916, Ark. Zool., 10, 9; Ball, 1932, Mém. Mus. Roy. Hist. Nat. Belg., 4, 4, p. 22, fig. 1b, 2b, pl. 1, fig. 5.

Macrogyrus (*Macrogyrus* s. str.) *howittii* J. Balf.-Browne 1945, Ann. Mag. Nat. Hist., ser. 11, vol. 12, p. 106.

Size 10·5 to 12 mm. Oval, very elongate; moderately convex. Upper surface very shining, black, with an aeneous hue, in some places with varicoloured reflections, especially on the head, the sides of pronotum and the apical portion of elytra. Lateral longitudinal striae on elytra greenish or purplish, the narrow side margin of pronotum and elytra green to bluish-green; under side black, epipleura, abdomen and legs rufescent. Labrum densely punctate, upper surface with an alutaceous sculpture consisting of nearly round meshes in the labrum and the sides of the head, pronotum and elytra, becoming a little finer and more elongate on the disc. Elytra with many fine transverse striolae and laterally with two indistinct longitudinal striae, marked by serial punctures; the inner one of these striae generally strongly abbreviated and reaching only about half the length of elytra, in some examples a very short third stria is remarkable at the base anteriorly. Apical portion of elytra with small depressions near the apex of the side margin and near the suture shortly before the truncature. The latter is convex, scarcely angulate in its middle in some examples exceptionally, the sutural angle is rounded, the outer angle but slightly marked. Anterior tibiae of ♂ short, gradually and rather strongly broadened from base to apex, the latter slightly obliquely truncate, exterior angle sharp, produced; anterior tarsi moderately broadened, attenuated towards the apex. Aedeagus a little shorter than the lateral lobes, rather broad, subparallel, strongly attenuated in the middle of its length, apical third gradually narrowed towards the apex, which is broadly rounded; lateral lobes very slender basally, broadened only in apical fourth.

Clark's types were collected at Moreton Bay by himself and Mr. Bakewell. Mjöberg (1916, *l.c.*) cites a specimen captured by himself at Mapleton, Blackall Range. These are the only exact records given in literature for this species. I have seen specimens from Melbourne (ex coll. Zimmermann) and from Scone, N. S. Wales (Australian Museum). Specimens from Tasmania are represented in the collections of the Hamburg Museum, Macleay Museum and American Museum. The Museum of Berlin has a small series from Tasmania, Dunalley (Rev. John Bufton).

Subg. 9. **Megalogyrus**, nov.

Size very large, up to 18 mm. More broadly oval than all other Australian species of the genus. Longitudinal striae on elytra reduced to fine lines, only 1 opaque stria laterally. Apex of elytra slightly bitruncate, only the exterior angle pointed.

Macrogyrus (Megalogyrus) striolatus (Guérin).

Gyrinus striolatus Guérin, 1830, in Duperrey, Voy. Coquille, Zool., 2, 2, p. 62, pl. 1, fig. 20; Boisd., 1835, Fn. Ent. Océan Pacif., 2, 51; Aubé, 1838, Spec. Col., 6, 656; Redtenb., 1868, Reise Novara, Zool., 2, 1, A1, 24.

Macrogyrus striolatus Rég., 1882, Ann. Soc. Ent. France, (6) 2, 434; Rég., 1884, Ann. Soc. Ent. France, (6) 3, (1883), 471; Sév., 1889, Ann. Soc. Ent. Belg., 33, 158; Rég., 1892, Ann. Soc. Ent. France, 60, (1891). 740.

Gyrinus striolatus Masters, 1896, Proc. Linn. Soc. N. S. Wales, 21, 698.

Macrogyrus fortissimus Blackb., 1901, Trans. Roy. Soc. S. Aust., 25, 126.

Macrogyrus striolatus Blackb., 1903, Trans. Roy. Soc. S. Aust., 27, 92; Rég., 1907, Ann. Soc. Ent. France, 76, 139, 156; Ahlw., 1910, Col. Cat., 21, 11; Mjöb., 1916, Ark. Zool., 10, 9; Zimmerm., 1917, Ent. Mitt., 6, 140; Tillyard, 1926, Ins. Aust. N. Zeal., p. 194, fig. R.20.

Size 15 to 18 mm., exceptionally only 12 mm. Broadly oval, more attenuated posteriorly than anteriorly, especially in the ♀; rather convex. Upper surface black, with a metallic hue and varicoloured reflections in some places, especially on the head and on the sides of pronotum and elytra; under side black, natatorial legs rufous. Head very shining, pronotum and elytra with a dull lustre. Upper surface with an alutaceous sculpture consisting of nearly round meshes strongly impressed on the sides of pronotum and elytra, less impressed on the disc of the latter, very superficial on the head. Head and disc of pronotum punctate, elytra with numerous fine transverse striolae and 7 faint longitudinal lines, the most exterior of which is accompanied by an opaque violet stria, reaching about half the length of elytra. Apex of the latter slightly bitruncate, sutural angles scarcely dehiscent, nearly rectangular, shortly rounded, median angle obtuse, exterior angle slightly pointed. Anterior tibiae slightly curved inwards, basal half nearly subparallel, broadened only in apical half, especially more so in the ♂, apex nearly horizontally truncate, exterior angle rectangular in ♀, sharp and produced in ♂; anterior tarsi of the latter broadened and attenuated towards the apex, subparallel in ♀. Aedeagus of the ♂ subparallel, relatively slender, a little shorter and narrower than the apical portion of the lateral lobes, attenuated in the middle of its length, apical third but scarcely narrowed, tip broad, flatly rounded.

Type Locality: Port Jackson (N. S. Wales). Blackburn's *fortissimus* was collected in the Blue Mountains (N. S. Wales). Further localities: N. S. Wales: Blue Mts. (F. H. Taylor, Aust. Mus.); Megalong Valley, 1,000 ft., 23.1.32 (Darlington, Harv. Exp. Mus. Cambridge, Mass.); Mt. Wilson, 3,500 ft., Jan., 1932 (ibid.); Wentworth Falls, Jan., 1932 (ibid.); Richmond River, 1909 (Brit. Mus.); Upp. Chichester, Blue Gum Knob, 28.9.21 (A. Musgrave, Aust. Mus.); Barrington Tops, 5,000 ft., 8–9.2.32 (Darlington, Harv. Exp., Mus. Cambridge, Mass.); The Dorrigo, 3,000 ft., Febr., 1932 (ibid.). S. Queensland: Nat. Park, McPherson Range, March, 1932, 3–4,000 ft. (ibid.); Mt. Tambourine (Hacker, Pottinger and other collectors, Queensl. Mus., Mus. Cambridge, Mass.); Brisbane (Queensl. Mus.).

The specimens from different localities vary to a certain degree in size, form of the body and other minor characters, and there are also individual aberrations. Among normal specimens from McPherson Range there was a small female measuring only about 12 mm. in length, having on elytra laterally a second opaque stria, though very narrow and reaching only about half the length of elytra. Moreover, anterior tibiae are less broadened and less curved than is the rule in this specimen.

Genus **Dineutus** Macleay, 1825.

Length 6 to 25 mm., the Australian species measuring but 6·5 to 9 mm. Scutellum invisible. Elytral striae faint. Outer portion of the metasternum in form of a large triangle. Anterior margin of metacoxae rather straight, reaching the meta-episternum before its apical end; lateral end of the raised portion of metacoxae obtuse. Anterior tarsi of the male scarcely broadened, subparallel, with a uniform dense brush of bristles beneath.

As in the former genus, the species of *Dineutus* are very different in size and other characters, from which were derived several subgenera (cf. Ochs, 1926, Ent. Z. Frankfurt, 40, 64–66), only two of which are represented in Australia by one species each. The Dineutini are distributed all over the world, with the exception of the Palearctic region and the South American continent, having a secondary centre of development, apparently of more recent origin, in New Guinea, whence 5 subgenera (2 endemic) are recorded; the small number of species occurring in Australia is noticeable.

Two species recorded in literature from Australia must be cancelled (cf. Ochs, 1926, Ent. Z. Frankfurt, 40, 192). *D. caliginosus* Rég. (1883, Ann. Soc. Ent. France, (6) 2, 397) is identical with *D. politus* Macleay, which is a common species in Java. By Mr. Peschet, who was able to study the type from the ancient collection of Mr. Wehncke, now in the collection of Mr. R. Oberthür, I was informed that it matches a small dark-coloured female specimen of the latter species. The indication "Australia" on the locality label is evidently erroneous. *D. inflatus* Blackburn (1895, Trans. Roy. Soc. S. Aust., 19, 28) is synonymous with *D. ciliatus* Forsberg (= *vittatus* Germar), as stated by Mr. Gilbert J. Arrow, who studied the type of Blackburn, now in the British Museum. "Victoria", which is given as locality in the description and on the label, is a locality in Mexico, where the species occurs, while Blackburn believed it to be collected in Victoria (Australia).

Key to Australian Species of Dineutus.

1. Pronotum and elytra not bordered with yellow. Elytra with a little tooth at the outer apical angle in the male, not toothed but straightly truncate in the female *D.* (*Cyclous*) *australis* Fabr.

1′. Pronotum and elytra bordered with yellow. Outer apical and medial angle of truncature spinous in both sexes .... Subgenous *Spinosodineutes* Hatch .. 2

2. Elongate-oval, subparallel. Spines of elytra longer and more acute. Anterior tibiae of the male straight .... *D.* (*Spinosodineutes*) *neohollandicus* Ochs.

2′. Less elongate, more broadly oval. Spines of elytra shorter and less acute. Anterior tibiae of the male strongly curved outwards basally .. *D.* (*Spinosodineutes*) *neoguineensis* Rég.

Dineutus (Cyclous) australis (Fabr.).

Gyrinus australis Fabr., 1775, Syst. Ent., 235; Modeer, 1776, Physiogr. Sällsk. Handl., 1, 3, p. 159; Fabr., 1781, Spec. Ins., 1, 298; Fabr., 1787, Mant. Ins., 1, 194; Gmelin, 1788, Syst. Nat., ed. XIII, 4, p. 1611; Fabr. 1792 Ent. Syst. 1, 203; Olivier, 1795, Ent., 3, 41, p. 12, pl. 1, f. 4; Fabr., 1801, Syst. Eleuth., 1, 275.

Gyrinus rufipes Fabr., 1801, Syst. Eleuth., 1, 276.

Gyrinus australis Schönherr, 1808, Syn. Ins., 1, 2, p. 38.

Gyrinus rufipes Schönherr, 1808, Syn. Ins., 1, 2, p. 39.

Gyrinus australis Forsberg, 1821, Nova Acta Upsal., 8, 303.

Gyrinus rufipes Forsberg, 1821, Nova Acta Upsal., 8, 306.

Gyrinus dentipennis Macleay, 1825, Annulosa Javan., ed. I, p. 30.

Gyrinus limbatus Macleay, 1825, Annulosa Javan., ed. I, p. 30.

Gyrinus dentipennis Macleay, 1833, Annulosa Javan., ed. II, p. 133.

Gyrinus limbatus Macleay, 1833, Annulosa Javan., ed. II, p. 133.

Dineutes australis Aubé, 1838, Spec. Col., 6, 785.

Gyrinus iridis Hope, 1842, Ann. Mag. Nat. Hist., 9, 428.

Dineutes australis Schaum., 1848, Ent. Ztg. Stettin, 9, 335.

Dineutus leucopoda Montr., 1860, Ann. Soc. Ent. France, (3) 8, 245.

Dineutes australis Fauvel, 1867, Bull. Soc. Linn. Normand., (2) 2, 77, t. 1, f. 13; Redtenb., 1868, Reise Novara, Zool., 2, I, A1, p. 24; Rég., 1882, Ann. Soc. Ent. France, (6) 2, 422, t. 12, f. 43, 43*a*.

Dineutes janthinus Rég., 1882, Ann. Soc. Ent. France, (6) 2, 421.

Dineutes australis Fauvel, 1883, Rev. Ent., 2, 347, 348; Rég., 1884, Ann. Soc. Ent. France (6) 3, (1883), 469.

Dineutes janthinus Rég., 1884, Ann. Soc. Ent. France, (6) 3, (1883), 469.

Dineutes australis Masters, 1885, Proc. Linn. Soc. N. S. Wales, 10, 598.

Dineutes rufipes Masters, 1885, Proc. Linn. Soc. N. S. Wales, 10, 599.

Gyrinus iridis Masters, 1885, Proc. Linn. Soc. N. S. Wales, 10, 598; Rég., 1886, Ann. Soc. Ent. France, (6) 6, 257.

Dineutes australis Sév., 1889, Ann. Soc. Ent. Belg., 33, 152.

Dineutes janthinus Sév., 1889, Ann. Soc. Ent. Belg., 33, 153.

Macrogyrus ? iridis Sév., 1889, Ann. Soc. Ent. Belg., 33, 157.

Dineutes australis Rég., 1892, Ann. Soc. Ent. France, 60, (1891), 739.

Dineutes janthinus Rég., 1892, Ann. Soc. Ent. France, 60, (1891), 739.

Dineutes australis Blackb., 1901, Trans. Roy. Soc. S. Aust., 25, 128.

Dineutes rufipes Blackb., 1901, Trans. Roy. Soc. S. Aust., 25, 128.

Dineutes australis Blackb., 1903, Trans. Roy. Soc. S. Aust., 27, 92; Fauvel, Rev. Ent., 22, 253; Jacobs, 1905, Käf. Russl., p. 437; Rég., 1907, Ann. Soc. Ent. France, 76, 138, 150.

Dineutes janthinus Rég., 1907, Ann. Soc. Ent. France, 76, 138.

Dineutes australis Ahlw., 1910, Col. Cat., 21, 4.

Dineutes janthinus Ahlw., 1910, Col. Cat., 21, 6.

Macrogyrus iridis Ahlw., 1910, Col. Cat., 21, 11; Mjöb., 1916, Ark. Zool., 10, 9.

Dineutes australis Mjöb., 1916, Ark. Zool., 10, 9; Zimmerm., 1917, Arch. Naturgesch., A, 82, (1916), 122; Zimmerm., 1917, Ent. Mitt., 6, 139; Kempers, 1923, Ent. Mitt., 12, 74, f. 85; Ochs, 1924, Philipp. J. Sci., 24, 81; Ochs, 1924, Ent. Bl., 20, 236; Winkler, 1924, Cat. Col. pal., 2, 238; Ochs, 1925, Ent. Bl., 21, 174; Peschet, 1925, Treubia, 7, 5.

Dineutus (*Cyclous*) *australis* Ochs, 1926, Ent. Z. Frankf., 40, 65, 114, 119, 133, 139; Hatch, 1926, Pap. Michig. Acad., 7, 311; Ochs, 1927, Ent. Bl., 23, 34.

Dineutes australis Ochs, 1927, Kol. Rdsch., 13, 39, 42.

Dineutus (*Cyclous*) *australis* Ochs, 1928, Ent. Bl., 24, 43; Ochs, 1929, Ent. Bl., 25, 200.

Dineutus australis Omer-Cooper, 1930, Proc. Zool. Soc. London, p. 420; Takizawa, 1931, Ins. Mats., 6, 15, 20.

Dineutus (*Cyclous*) *australis* Ochs, 1931, Arch. Hydrobiol., Suppl. 8, 463, 464, 467, 473; Ochs, 1931, Lingnan Sci. J., 7, (1929), 718; Wu, 1932, Peking Nat. Hist. Bull., 6, 69; Cheo, 1933, Peking Nat. Hist. Bull., 7, 319; Cheo, 1934, Peking Nat. Hist. Bull., 8, 220, pl. 1, f. 8, 9, pl. 2, f. 10, 17, 18.

Dineutus australis Ochs, 1934, Mitt. Schweiz. Ent. Ges., 16, 100; 1935, Rev. Ent. Rio, 5, 125; 1936, Festschr. Strand, 1, 602, 604.

Dineutus (*Cyclous*) *australis* Ochs, 1937, Decheniana, 95B, 67, 70.

Dineutus australis Ochs, 1937, Arch. Hydrobiol., Suppl. 15, 110, 111; Guignot, Mém. Mus. Nat. Hist. Natur. Paris (n.s.), 9, Miss. sci. Omo, 5, 43, p. 58.

Dineutus (*Cyclous*) *australis* Ochs, 1940, Arb. Morph. Taxon. Ent., 7, 37, 42, 44, 50.

Dineutus australis Ochs, 1942, Mitt. Münch. Ent. Ges., 32, 206.

Dineutus (*Cyclous*) *australis* J. Balf.-Browne, 1945, Occ. Pap. B. P. Bish. Mus., 18, 108, 115; J. Balf.-Browne, 1945, Ann. Mag. Nat. Hist., ser. 11, vol. 12, p. 104, 108.

Length 6·5 to 9 mm. Oval, ♀ more elongate than the ♂, moderately convex. Disc of upper surface bronzed, shining, sides opaque, with violet, blue or green reflections; under surface black, natatorial tibiae and tarsi rufescent. Upper surface remotely punctate and having an alutaceous sculpture consisting of nearly round meshes. Elytra with a lateral impression, longitudinal striae faint, more strongly impressed towards the sides; elytral apex serrulate. Truncature straight and slightly convex in the female, outer apical angle distinct. In the male the elytral apex is produced, forming an obtuse angle which is broadly rounded, the inner portion of truncature being less oblique and broader than the outer one; the apex of side margin produced in a small spine. Aedeagus slender, as long as the lateral lobes, gradually narrowing from base to apex, tip very narrowly rounded.

Type Locality.—In Novae Hollandiae aquis. Apparently the species is rather common and widely distributed in Australia, from where I registered the following data:

Victoria: No exact locality given.
N. S. Wales: Liverpool.
Queensland: Brisbane, Ipswich, Sandgate, Rockhampton, Blackall Range, Mossman, Mitchell River, Port Denison, Townsville, Cairns, Cooktown, Atherton Tableland, Yungaburra, Cedar Creek, Malanda, Bellenden Ker, Herberton, Coën.
N. Australia: Port Essington, Port Darwin, Burnside, Katherine, Kimberley Dt., Noonkanbah.
W. Australia: Rockingham, Wiluna.
S. Australia: No exact locality given.
Thursday Island; Morilug.

The species is furthermore recorded from Liu-Kiu, Formosa, S. China, Philippine Islands, Celebes, Java, Bali, Lombok, Soemba, Kisser Islands, New Hebrides, New Caledonia, Fiji and Niuafu. There are mentioned some more localities in literature, which are, however, doubtful. This concerns especially the record New Zealand, where *G. convexiusculus* is probably the only representative of the family.

In the series there are sometimes specimens of a dull black colour, which occurs regularly in the metallic species; also rufinotic specimens are frequently to be found. There is a certain variability in the series from the above localities if compared, but the differences are not so important as to consider these forms as racially or even specifically distinct. Only the specimens from Niuafu showed distinguishing characters of more importance (ssp. *ultimus* m., 1927, Ent. Bl., 23, 34).

Cheo (1934, *l.c.*, pl. 2, fig. 10) gives an illustration of the aedeagus of *D. australis*, which must be erroneous. Also in S. Chinese males (which are a little larger in size, more broadly oval and more gibbous than Australian specimens) the aedeagus is not shorter than the lateral lobes and is not angularly widened in middle of length, as described and drawn by the Chinese author.

Dineutus (Spinosodineutes) neohollandicus Ochs.

Dineutes neo-guineensis Rég., 1907, Ann. Soc. Ent. France, 76, 151 (partim); Ahlw., 1910, Col. Cat., 21, 7 (partim); Mjöberg, 1916, Ark. Zool., 10, 9; Peschet, 1925, Treubia, 7, 6 (partim).

Dineutus (Gyrinodineutus) neohollandicus Ochs, 1926, Ent. Z. Frankfurt, 40, 119, 121, 136, 191; Ochs, 1929, Ent. Bl., 25, 199.

Size 7·5 to 8 mm. Oval, somewhat elongate, a little more attenuated anteriorly; rather convex, depressed behind, a little more so in ♂. Upper surface shining, darkly olive-coloured, with violet reflections; labrum green, clypeus coppery, pronotum and elytra with a yellow margin, accompanied by a dark narrow border exteriorly and a metallic green stripe interiorly. Under side and legs rufescent, epipleura yellow. On the yellow margin of elytra there is a dark metallic green spot in the posthumeral portion, where the knee of anterior legs is inserted beneath, this spot being somewhat larger in the ♂. Elytra slightly compressed exteriorly behind the posthumeral portion, bearing 3 longitudinal striae on the outer portion, striae aeneous to coppery, interstices dark blue to purplish; in the ♀ there is a strongly alutaceous spot at the base of elytra beside the scutellar region. Truncature strongly protruding posteriorly, with an apical spine and a second spine at the end of the exterior margin; in the ♀ the spines are longer and the emargination at the inner side of the outer spine is deeper. Anterior tibiae of ♂ nearly straight, aedeagus shorter than lateral lobes, slender, narrowing gradually from base to apex, somewhat constricted in the middle of length, tip very fine and acute.

My type specimens, bought from Staudinger, are labelled "Australia", without precise indication of locality. Further records are:

N. Australia: Port Darwin (Macleay Museum); Adelaide River (Brit. Mus., sec. Régimbart).

Queensland: Cape York (Dämel, Mus. Berlin); Gregory River (Dr. J. B., Queensl. Mus.); Gordonvale (Illingworth, Queensl. Mus.); Cairns (Queensl. Mus. and Mus. Cambridge, Mass.); Brisbane (Queensl. Mus.).

Victoria (?): (Mus. Dresden).

Régimbart (1907, *l.c.*) believed the specimens from Adelaide River to be identical with *D. neoguineensis* from N. Guinea (the Buru specimens mentioned by Peschet (1925, *l.c.*) belonging probably to a third species). I did recognize the new Australian species only after most of the specimens mentioned above had passed through my hands without exciting my attention. Therefore it might be possible that both species exist in Australia side by side, although I do not believe it. At all events I joined the characters of both in the key given above, in order to enable students to distinguish these closely allied species.

Considerations about Phylogeny and Zoogeography.

The composition of the gyrinid fauna of Australia is very peculiar and seems to allow some conclusions about phylogeny and zoogeography. These themes, relative to the whole family, were discussed by several authors in the last twenty years. Independently, by thorough systematic studies of many years, Dr. F. Guignot(1) and myself(2) arrived at nearly the same results, stating that the origin of the Gyrinidae took place in the earliest period of the adephagous stock, and that they are by no means direct descendants of the Dytiscidae. Following the example of Leng(3) and Tillyard,(4) I therefore placed the Gyrinoidea side by side with the Caraboidea in the adephagous suborder.(5) Melville H. Hatch,(6) in the course of a careful comparative study of the exoskeleton, took almost diametrically opposed views. It must, however, be considered that his investigations were confined to a relatively small number of species, not including the most instructive with regard to intergeneric relationship, and that, therefore, in generalizing, he risked arriving at inaccurate conclusions. Omer-Cooper,(7) apparently attributing too much value to the similarity of some dystiscid larvae to those of the Gyrinidae, supports, like Hatch, the direct descent of the latter from Dytiscidae, and both authors cite *Palaeogyrinus strigatus* Schlecht.(8) as the link between the two families. Unfortunately, however, this fossil was rediscovered meantime in large number and studied thoroughly by Prof. Statz,(9) who concluded that it is doubtless a dytiscid beetle and that it owes its name to the fact that its legs were wrongly restored by the author, as already presumed by Darlington.(10) Therefore, so-called *Palaeogyrinus* can no longer be used for proof of descent of the Gyrinidae from Dytiscidae, which theory is also not supported by other fossils. In my opinion, and as formerly expressed by Darlington,(10) all fossil Gyrinidae should be thoroughly revised to determine whether they are correctly interpreted as belonging to the family in general, which concerns their relationship to recent genera. For instance, *Dineutus* Heer(11) and *Miodineutus* Hatch(12) seem very doubtful. According to Heer, these insects had a size of only about 7 to 7·5 mm. (ano excepto); if, therefore, they belong really to *Dineutus*, this would affirm my theory, that the ancestors of now living forms were smaller in size.

In my opinion characters of Gyrinidae are to be valued as follows:

	Primitive.	*Derivative.*
Size of the body	Small.	Large.
Form of the body	Moderately elongate.	Very elongate, broadly oval or other peculiar forms.
Convexity	Moderate.	Strong.
Alutaceous sculpture of the upper surface	Strong.	Fine or absent.
Pubescence of pronotum and elytra	Rudimentary.	Entirely absent or more or less perfect.
Colour of upper surface	Brown to black or olive-coloured.	Blue, violet, brassy, red patterns.
Colour of under side	Rufescent.	Dark metallic or pale yellow.
Side margin	Yellow.	Not yellow.
Labrum	Transverse.	Prominent.
Pronotum	With grooves.	Without grooves.
Scutellum	Present.	Wanting.
Elytra	With eleven longitudinal striae.	Longitudinal striae reduced in number; abbreviated or more or less obliterated.
Suture of elytra	Bordered.	Not bordered.
Truncature of elytra	Convex.	Truncate, concave or bitruncate; with points or spines. (In the larger species the latter may be reduced secondarily.)

	Primitive.	*Derivative.*
Pygidium	Flat and short.	Conical, elongate, with a longitudinal row of hairs beneath.
Anterior legs	Simple.	More or less modified.
Metacoxae	Outer (deeper) portion broader than the inner one.	Inner portion, which adjoins the metasternum, broader than the outer (deeper) one.
Metasternum	Outer portion narrow, elongate.	Outer portion broad, in form of an equilateral triangle.

The sum of primitive characters, as enumerated above, constitutes an insect very like *Gyrinus haasi*, which was discovered some years ago by Dr. Fritz Haas in Africa in the vicinity of Lake Moero and embodies very well a primitive gyrinid beetle.

The composition of the gyrinid fauna of Australia and its relation to other areas is illustrated by the accompanying table; it comprises 17 species in all, 14 of which are endemic, and only 3 have a wider range. (See table on page 197.)

The *Gyrini caudati* (Orectochilinae) are totally wanting in Australia. They are distinguished from the *Gyrini incaudati* (Gyrininae and Enhydrinae) by the feature of the last abdominal segment, which is elongate and of conical form, with a longitudinal row of hairs beneath, thus representing a perfect rudder, inasmuch as it is movable in every sense. Moreover, in this group the upper surface is more or less covered with short hairs, this tomentous covering serving to protect the insect from moisture and therefore favouring its water life. By these acquisitions, accompanied mostly by exquisite streamline shape, this subfamily is evidently the most highly evolved and therefore of more recent origin, which is clearly shown by its distribution. The Orectochilinae are represented by three genera which, without mentioning a few exceptions, are distributed in the following manner: *Orectochilus*, Indo-Malayan; *Gyretes*, Neotropic; and *Orectogyrus*, Ethiopic. This means that this last offshoot of the family had its origin in the southern hemisphere and that its development became active only after the ancient Gondwana continent had been divided into its present parts (Australia, India, Africa and South America). According to the nearly unanimous opinion of the palaeogeographers this Gondwana continent comprised all the recent continents of the southern hemisphere in Mesozoic time and was separated from the then existing continents of the northern hemisphere by a large ocean. It divided itself in Cretaceous time, wherefore the development of the *Gyrini caudati* must have taken place towards the end of the latter period or in early Tertiary. Australia having been separated already in later Jurassic time, the Orectochilinae were therefore prohibited from entry to this territory.

Apparently the Gyrininae are the earliest offshoot of the family. Of these the tribe Gyrinini (genus *Gyrinus*) has a world-wide distribution, but seems to originate from the northern hemisphere, where the genus occurs abundantly, while it is relatively scarcely represented in the southern hemisphere. On the contrary, the tribe Aulonogyrinini (*Aulonogyrus* and *Paragyrinus*) is evidently of Gondwana origin, as proved by its distribution, and the Australian species (*Aulonogyrus strigosus*) is certainly a remnant from ancient times, before Australia became isolated. *Gyrinus convexiusculus*, the only Australian representative of this genus, might have migrated there, as this species spreads very widely, which seems to indicate an increased faculty of change of place, belonging apparently only to certain species of the family. Active migration of these beetles is, however, restrained by the fact that they are very sensitive concerning desiccation and influence of sunlight, which, as proved by experiment, they endure only for a relatively short time. Moreover, the beetles are not able to rest at sea-level, because of the pernicious effect of salt-water, wherefrom results the impossibility of travelling over large distances by air. *G. convexiusculus*, which

	South America.	New Zealand.	Fiji Islands.	New Caledonia.	New Hebrides.	Solomon Islds.	Ceylon.	India.	Indo-China.	South China	Manchuria.	Korea.	Japan.	Loo-Choo Islands.	Formosa.	Philippine Islds.	Borneo.	Celebes.	Sumatra.	Java.	Bali.	Lombok.	Flores, Soembawa.	Soemba.	Rotti.	Timor (Kisser).	Boeroe.	Ceram.	Aroe and Key Islds.	New Guinea and Adjacent Islds.	Morilug.	Thursday Island.	Tasmania.	Australia.
Gyrinus—																																		
convexiusculus		+		+			+	+	+	+				×					+	+										×				+
Aulonogyrus—																																		
strigosus				×			×	×																									+	+
Macrogyrus—																																		
(*Orectomimus*)—																																		
paradoxus																																		+
darlingtoni																																		+
(*Tribolomimus*)—																																		
gouldi																									×		×							+
(*Australogyrus*)—																																		
oblongus																																		+
rivularis																																		+
viridisulcatus																																		+
(*Clarkogyrus*)—																																		
reichei																																		+
(*Tribologyrus*)—																																		
australis																																		+
angustatus																		×				×	×	×		×		×		×				+
finschi																															+			+
elongatus-laevis																													+	+				+
(*Macrogyrus*)—																																		
howitti	!																																+	+
(*Megalogyrus*)—																																		
striolatus	!																																	+
Dineutus—																																		
(*Cyclous*)—!																																		
australis			+	+	+					+				+	+	+		+		+	+	+		+		(+)	+				+	+		+
(*Spinosodineutes*)—																																		
neohollandicus						×		×	×	×	×	×	×	×	×		×		×											×				+

+ = Same species as in Australia.

× = Closely allied species.

! = Closely allied genus.

occurs also in New Zealand, which it could not reach otherwise in recent time, must therefore have existed in its present form in early Tertiary, when a land-bridge existed connecting Australia and Tasmania to New Zealand, which enabled the insect to pass there.

This land-bridge continued by Antarctica to South America, by which is explained the high degree of affinity of Australian *Macrogyrus* with South American *Andogyrus*. Certainly, and contrary to what is believed by Hatch, the latter and also the South American *Enhydrus*, which are still more developed, must be derived from the former. *Macrogyrus*, and especially its subgenera which are confined to Australia, comprises very primitive species, from which may be concluded that the centre of dispersal of the Enhydrini was situated on the Australian mainland, from where they migrated partly to New Guinea and the Melanesian Archipelago, partly by the Antarctic land-bridge to South America, there giving rise to *Andogyrus* and *Enhydrus*. In the course of its development, *Macrogyrus* finished by producing very different species, by which I was led to the classification given above, the majority of the subgenera there established living in Australia. Of these subgenera 5 are endemic in Australia, 2 are peculiar to the Melanesian offshoot of the genus, and only 2 are represented on the Australian mainland, as well as in New Guinea and the Melanesian archipelago; in the last-mentioned subgenera Australian species are in minority and most of them are evidently primitive.

There are two large groups in the genus *Macrogyrus*, in one of which the narrow outer portion of the metasternum resembles a gyrinoid feature, while in the second group the outer portion of metasternum is developed analogously to that of *Enhydrus* and *Dineutus*. Within both groups further division was based on the feature of the truncature of the elytra, which seems significant with reference to presumptive evolution of the genus and of the family in general. The apex of the elytra is more or less convex in more primitive species, as for instance in *Gyrinus convexiusculus* and *Aulonogyrus strigosus*. In the course of development there appears a horizontal truncature as in *D. australis* ♀, which may become somewhat oblique in vaulted forms. Probably in connexion with adaptation for life in swift running water, there exists in the family a tendency for formation of points or spines at the end of elytra. There is only one point at the exterior angle in *D. australis* ♂ and also in *Clarkogyrus*, *Macrogyrus*, s. str., and *Megalogyrus*, although strongly reduced in the latter. In *D. neohollandicus* and in *Orectomimus* the sutural angle is also pointed, and in the latter a third point begins to rise in the middle of truncature, which is more or less evident in the other subgenera. Having attained a certain size in the course of evolution, the larger species, if not especially bound to swift-running water, show the tendency of reducing these prominences as well in *Macrogyrus* as in *Dineutus*. In *Australogyrus*, for instance, sutural and medial angles are already reduced, in *Clarkogyrus* they disappeared completely and only the outer angle is kept, the latter being almost totally reduced in *Macrogyrus*, s. str. In *Megalogyrus*, in which the apical points are very reduced, the increase of length is accompanied by a strong progression in width, which occurs in *Enhydrus* and *Dineutus*. Very interesting is the retention of primitive characters (imperfect streamline shape and strong longitudinal striae on elytra) in *Clarkogyrus*, which has a highly evolved truncature, and in *Australogyrus*, despite the beginning of reduction of apical points and of extremely developed anterior legs in the ♂. The most significant species in phylogenetical view is *M. paradoxus*, which, in the form of its body and the shape of metasternum and metacoxae, has much affinity to orectochilin feature, from which I concluded that more primitive ancestors of this species might have been the common prototype of both the enhydrin and the orectochilin stock.

With regard to Australian *Dineutus*, it should be mentioned that *D. neohollandicus* has its nearest ally in New Guinea and that other closely allied species are living in the Indo-Malayan region. For explanation of a possible migration between the two regions it is necessary to go back to Jurassic time. A very peculiar species belonging to the same group (*D. heterandrus* Ochs(13)) was discovered some years ago in Bougainville, the characters of which seem to allow the conclusion that from these small yellow-bordered species are to be derived the large, highly developed *Callistodineutus* occurring in the Fiji Islands. For migration there must have been a land-bridge in late Cretaceous time, which also explains the occurrence of *Macrogyrus* and *Aulonogyrus* in New Caledonia and migration of *D. australis* to Fiji and Niuafu. The latter species occurs also in the Indo-Malayan region and probably existed in Jurassic time, when large reptiles ruled over the animal kingdom, and a long while before the evolution of human beings began; certainly a remarkable proof for the stability of germ-plasm.

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THE KREFFT TOOTH—IS IT A HUMAN MOLAR?

By T. D. Campbell,
Adelaide.

(Plate xiv and one Figure.)

This tooth fragment has had a long and somewhat varied career in Australian palaeontology in relation to the problem of man's existence on this continent. Its importance has been one of wax and wane—for there seems always to have been some doubt as to its authenticity as a human fossil fragment.

Through the courtesy of the Director of the Australian Museum, Sydney, the present writer has had the opportunity of making a close study of the specimen.

The question of the geological age of this tooth fragment involves the general material from the site of its discovery—Wellington Caves in New South Wales—and is outside the scope of the present study, which is solely a matter of dental anatomy. As the specimen never seems to have had the critical attention of anyone specially interested in human dental anatomy, the present account is an attempt seriously to review the question of its human origin or not.

The following references and brief extracts do not entail a complete bibliography of the Krefft tooth, but will be sufficient to give an outline of the history of this interesting specimen.

In 1867, in a list of fossil and recent Australian vertebrata, Krefft records: "Homo. Melanian variety. Bones of the extremities found in a cave at Wellington Valley—left and right femur, left and right tibia, left and right humerus, portion of fibula."

In 1870, in a museum guide to fossil remains exhibited, Krefft mentioned portion of a molar tooth he had found among fossil material from the Wellington Caves, associated with such remains as Diprotodon and Thylacoleo.

In 1871, in a later edition of the 1867 list of vertebrata, he wrote: "Of man, we have but scanty evidence regarding the length of his existence here; in not one instance were weapons or implements obtained with the remains of fossil animals." No reference was made to the tooth fragment.

In 1874, in an article discussing the finding of fossil remains of a large extinct wingless bird in Australia, Krefft made the following statement: "I have found the fractured crown of a human molar in the same matrix as Diprotodon and Thylacoleo at Wellington in this Colony. Man may therefore have been the contemporary of these animals and also of Dromornis."

In 1882, in connection with the Wellington Caves material, Krefft compiled a "List of photographs of Australian fossils", for transmission to Professor Owen. The description (p. 5) of the figures and the illustrations at the end of the volume (including two of the supposed human molar) do not appear to correspond. And incidentally, the list of descriptions for Plate II contains the statement: ". . . also the 5th metatarsal bone of a man (recent)." This may have been included among the bones referred to in the 1867 extract. The 1882 reference includes this metatarsal bone among fossils; and if it is to be considered as such, it seems to have been overlooked in subsequent discussions on Australian human fossil remains. Of its significance the present writer can make no suggestion. Also on page 7 of this 1882 publication is a reply from Owen to Krefft, which includes the statement: ". . . the only disappointment was the absence of human remains and works." And later, page 13, is the statement: "In the Caves at Wellington, no vestiges of man, whether in the shape of bones, weapons, or works of art, have been discovered."

The above extracts show the doubtful occurrence of man as a fossil in the Wellington Caves.

R. Etheridge, junior, wrote a number of papers, ranging from 1890 to 1916, in which he made reference to the Krefft tooth. It will not be necessary to quote from more than one of his articles (1890) to show his views on this particular specimen. This paper includes a more lengthy account of the tooth fragment, thus providing a further chapter in its history. He wrote (p. 262): "We now come to what would at first sight appear to be the most reliable evidence of the geological antiquity of Australian man, but after a careful weighing of the facts I do not feel justified in attaching to it that amount of importance which the discovery would seem to warrant. I refer to the important statement by the late Gerard Krefft, which he published on at least two occasions, of the occurrence of a human tooth in the Wellington Cave breccia." On page 263 he went on to say: "That it is the crown of a human molar is, I think, beyond much doubt; but to guard against mistake I placed the specimen in the hands of Mr. P. R. Pedley,* who corroborates Mr. Krefft's determination, and further suggests that it is probably of the upper right series." Then on page 264 follows a detailed account of the tooth fragment which will be referred to later. On page 265 he stated: "The tooth appears to be completely fossilised, for in comparing it with the teeth of the larger marsupials from the Wellington Caves, the mineral condition is without question similar." Then again: "To sum up, it may be fairly stated . . . that the molar crown found in the Wellington Breccia Cave appears to be that of a human being, and is to all intents and purposes a fossil."

C. Anderson (1926) considered the tooth may belong to a later period than the bones of the fossil breccia.

More recently, the late D. J. Mahony (1943) published an excellent paper summarizing the subject of man's antiquity in Australia. He referred to the Krefft tooth; but here again the authenticity of the specimen is left under a shadow of doubt.

Very little attempt has been made in the past to describe the fragment in detail. The following statement by Etheridge provides the most complete account of the tooth which has been given in earlier discussions. Although his description of the specimen provides little of dental anatomical detail, his wording, as well as the photograph (Pl. xiv, fig. 1) and the diagrams (Pl. xiv, fig. 2) in this paper, will be sufficient to give an idea of its features as they appealed to him. The aspects of the specimen shown in Pl. xiv, fig. 2, have been named in accordance with Etheridge's opinion that it represents an upper molar. The terms used are solely for convenience of discussion and not to be accepted as correct anatomical appelations.

Etheridge (1890, p. 264) described it thus: "The molar consists of about two-thirds of the crown broken off from the remainder of the tooth, the under surface exposing the fractured dentine. The entire crown is so much worn as to almost reach the alveolar border. Regarding the tooth as an upper right molar, the two inner cusps are almost worn away, leaving the sulcus dividing them now, as a ridge. The inner anterior cusp is the portion broken away, the inner posterior being ground quite flat. The outer cusps are worn almost into concavities exposing the dentine, the enamel forming a ring or wall round the inner margin."

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* Mr. P. R. Pedley was a well-known Sydney dentist who took a keen interest in Natural History. He was for many years a prominent worker in the Microscopical Section of the Royal Society of New South Wales. He and Robert Etheridge were fellow members of the Council of the Linnean Society of New South Wales at the time Etheridge's paper (1890) was published. He died in 1918.—Ed.

Designation as a Tooth.—That the specimen is a tooth fragment need not be a matter of doubt. The confirmation of its constituent structure by sectioning and microscopic examination might clarify the type of enamel represented—whether human or marsupial. But it is obvious that all who have examined the specimen agree that it shows a remnant of crown enamel and underlying dentine—the latter changed by fossilization.

The broken condition of the specimen and its state of wear have undoubtedly provided a problem concerning its origin, human or otherwise, and the kind of tooth it represents.

Krefft went no further than describing it as "the fractured crown of a human molar". From the quotation above, it is seen that Etheridge was apparently convinced that it represents a human tooth—the crown of a human molar. Also, that his consultant, Mr. P. R. Pedley, corroborated Krefft's determination and further suggested that it is probably of the upper right series.

Description of the Fragment.—For the purposes of description and development of subsequent argument, this coronal fragment is treated in its former designation as if it were portion of an upper right molar. But it must be remembered that the dental terminology here applied is solely for descriptive convenience.

Plate xiv, fig. 1, is a photograph of the specimen; Plate xiv, fig. 2, provides outline sketches of the specimen from various aspects; Plate xiv, fig. 3, is an enlarged diagram provided for descriptive references.

The bucco-lingual and mesio-distal diameters of the fragment are 11·6 mm. and 11·0 mm. respectively. The maximum thickness of the fragment is 7 mm.—in the disto-buccal region.

Viewed from the occlusal aspect (Pl. xiv, fig. 3) the sides of the fragment are marked: B, remnant of the buccal surface; D, distal border; L. lingual border; and M, M, the broken edges of the mesial aspect.

From the buccal view (Pl. xiv, fig. 2, B) only a portion of the enamel remains and the broken inner tissue is exposed.

From the distal aspect (Pl. xiv, fig. 2, D) the main feature of interest is an irregular "worn facet" on the buccal side of the surface (marked × and in dotted outline); this will be dealt with in more detail later.

The mesial aspect, M, presents mainly the markedly broken, irregular exposure of the inner material.

The lingual aspect is important. When viewed as in Plate xiv, fig. 2, L, its lingual features are not as striking as when viewed from an occluso-lingual angle. From this latter aspect it presents three slight convexities, better indicated by reference to Plate xiv, fig. 3, *c*, *d*, and *e*. Surfaces D and L show fine, vertical, brown-stained enamel fractures. But on surface L these three convexities are well defined by the presence of two main fracture lines, more complete and more deeply stained.

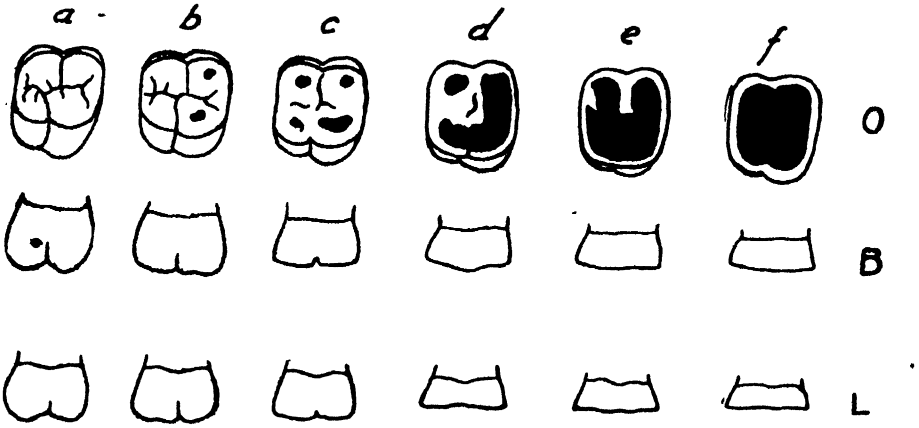
The occlusal surface is the most interesting and important as far as detailed examination of the specimen is concerned.

Reference to Plate xiv, fig. 3.—The peripheral margin of the fragment, *a*, *b*, *c*, *d*, *e*, has the appearance of enamel and has a definite translucency when examined by transmitted light. The worn margin at *a* forms approximately a right angle with the buccal surface; while those at *b*, and *c*, *d*, *e*, are worn rounded margins, particularly at *c*, *d*, *e*, which presents a well-rounded "angle" with the lingual surface. The area *f* is also a hard, polished, whitish tissue, continuous with the enamel margin *a* at the disto-buccal angle, and its central portion appears to be the basal portion of a former enamel eminence. The ridge portions marked *g*, *g*, *g*, *g* also are hard, compact tissue similar to *f*. The areas *h*, *h* are slight depressions associated with the *g* portions. This *g* and *h* region also has the appearance of being a worn-down basic portion of what may have been an enamel ridge formation of the original occlusal surface, but more complex than any part of a human molar. The central main *g* eminence is a worn, but definite, transverse ridge; those towards the mesial side are smaller and less definite. The areas *i* and *j* are "cupped out" depressions (*i* much the larger and deeper) and have the appearance of being a softer material—indicated by scratches on the depression *i*, which has a dull surface compared with the enamel, and no doubt represents fossilized dentine. There is also a small depression due to fracture at the corner *k*.

The under surface of the fragment (Pl. xiv, fig. 2, U) presents an irregular broken mass of dentine. Apart from a fairly well-defined elongate depression at P, about two to three millimetres in depth, which has the appearance of being the remnant of a pulp cavity, this surface does not provide any features of significance.

DISCUSSION.

As was stated in the above description, for purposes of discussion, the assumption of previous workers has been adopted—that the tooth is an upper right molar. But in Etheridge's acceptance of this and from his description it is difficult to decide what he actually meant when he wrote of "inner" and "outer" cusps. He said ". . . the two inner cusps are almost worn away, leaving the sulcus dividing them now, as a ridge". Presumably this ridge is the central transverse ridge *f* in Plate xiv, fig. 3. Then he went on to say ". . . the outer cusps are worn almost into concavities exposing the dentine, the enamel forming a ring or wall round the inner margin". The only portions which can be considered concavities are those marked *i*, *j*, and *h*, *h* in Plate xiv, fig. 3. One can only conclude that his descriptive terms are mixed and incorrect.



Text-figure 1.

This previously accepted designation does not fit in with conditions seen in much-worn human molars, which can best be illustrated by comparison with conditions of wear seen in the molars of Australian aborigines.

For purposes of comparative study a series of drawings made from actual aboriginal molars is given in Text-fig. 1. These show progressive stages of occlusal wear and may be briefly described as follows:

As occlusal wear of a molar takes place, first the cusp apices are worn down until the underlying and corresponding "cusps" of dentine are exposed (Text-fig. 1, *b* and *c*). At the same time the superficial enamel grooves or crenations steadily become obliterated. Then attrition of the enamel proceeds with further cusp reduction, leaving larger areas of exposed dentine. These exposed dentine areas, being of softer material than enamel, tend to be "cupped out", leaving some residual enamel as peripheral and transverse-inter-dentine ridges (Text-fig. 1, *d*). At this stage occlusal wear has reduced the height of the crown to about half of its original height. Further attrition obliterates the transverse enamel remnants or ridges, leaving the whole occlusal surface as an area of dentine surrounded by a narrow marginal ridge of enamel (Text-fig. 1, *f*). More extensive wear will reduce the crown height very considerably, and in extreme examples even the peripheral rim of enamel might disappear when the crown is reduced almost to gum level. A significant point is that on the first upper molar the occlusal reduction is greater on the lingual than on the buccal portion of the crown.

Comparing the aboriginal upper molars with the Krefft tooth and considering remaining crown height, the condition of the latter must be considered to represent a fairly marked degree of attrition—probably corresponding to stage *e* of the aboriginal series.

Considering the tooth, as Etheridge suggests, to be part of an upper right molar, the following points seem important.

(1) Examining it on the score of occlusal wear: If, as has been suggested, the portion of the crown showing greatest wear is the inner or lingual part, the state of crown reduction would probably correspond with the condition shown in stage *e* of the worn series in Text-fig. 1. A crown reduced to this extent could not present the definite residual transverse ridge of occlusal enamel as it occurs in the Krefft specimen at *g*, Pl. xiv, fig. 3. For the same reason it is difficult to explain the persistence of the lesser ridges marked *g*. There is no occlusal enamel which could remain in the particular manner presented in the Krefft tooth.

(2) An upper right molar does not present the marginal contour as seen in the Krefft tooth at L, Plate xiv, fig. 3. The two main convexities, *c* and *d* might be considered remnant curves of the disto-lingual and mesio-lingual cusps, but that at *e* entirely destroys the typical contour between the mesio-lingual cusp and the mesial margin of the crown. This feature is not in accord with the lingual or buccal contour of any human upper right molar, aboriginal or otherwise.

(3) If an attempt be made to complete the occlusal outline of the Krefft specimen in accord with the usual contour of an upper molar, its appearance would probably be something like that shown in Plate xiv, fig. 4, B. This is a result quite unlike any seen in the series of Text-fig. 1. Also this result would probably produce a type of crown in which the antero-posterior diameter would be greater than the bucco-lingual—a proportion not in keeping with usual conditions found in aboriginal or any other human upper molars. It seems that any attempt to restore the original outline gives a result incompatible with the outline of any upper human molar—that of a second or third upper molar even more so than a first.

To proceed a little further with consideration of the specimen being a human molar fragment by completing its contour: With more justification it might have been looked on as portion of a lower molar. All who have previously examined the tooth seem to have considered it an upper molar, but no specific and detailed reasons were given for such a designation. By again viewing the occlusal aspect an outline restoration as in C of Plate xiv, fig. 4, might suggest the appearance of a lower left first molar, the convexities (*c*, *d* and *e* of Plate xiv, fig. 3) representing remnants of the mesio-buccal, disto-buccal and distal (or 5th) cusps of the buccal border. Such an interpretation of this border would be more in accord with usual conditions than treating it as the lingual margin of an upper molar.

However, again applying the criteria of amount of wear and persistence of enamel ridges, the present writer feels that any assumption of it being a lower molar remnant is also unjustified. In the aboriginal lower molar, the greater wear is on the buccal side, again with obliteration of the occlusal enamel features.

The "Worn Facet".—On the assumed distal surface, and involving the disto-buccal angle, is an irregular facet (Pl. xiv, fig. 2, D, x). This feature also attracted the attention of Professor A. N. Burkitt, who mentioned it to the writer in a private communication as possibly similar to the worn facets on the proximal surfaces of aboriginal teeth. But close examination shows it to be quite unlike the usual interproximal worn facet seen on aboriginal molars. Instead of being a flat or evenly curved facet, that seen on the Krefft tooth is an irregular, shallow depression. Moreover, the position of the facet is not the same as in aboriginal teeth. In the latter, if the wear has not been sufficient to form a facet extending appreciably both buccally and lingually, then it commences more to the lingual side of the distal surface of a molar and not towards the buccal angle, as situated in the specimen under discussion.

As an experimental study to further this examination, the writer has taken an aboriginal and a modern white upper molar, both of dimensions approximately comparable with the Krefft fragment, and ground them down to simulate the broken shape and the stage of wear presented by the fossil tooth. The result is shown in Plate xiv, fig. 5. It will be seen that the features of the occlusal aspect of the ground specimens bear little resemblance at all to those of the Krefft tooth and provide further support to the above lines of argument.

As mentioned above, the under surface of the fragment in its present state provides no evidence which helps in its designation.

Consideration of the above points of detail in which the Krefft specimen is so much at variance with the typical conditions of upper aboriginal molars—or any other human tooth—has convinced the present writer that the previously suggested designations of the fragment are incorrect. The criteria of wear, contour, transverse enamel ridge persistence, all go to make it unacceptable as a fragment of any human tooth.

It seemed that the next step should entail an intensive comparative study of this fossil tooth with marsupial teeth, modern and fossil. Mr. H. H. Finlayson, Honorary Curator in Mammalogy at the South Australian Museum, has examined the specimen and his investigations are published in this issue of the RECORDS.* It is likely that only by such a study, and possibly with sectioning and microscopic examination of the specimen, will it be possible to secure a complete explanation of the Krefft tooth—a dental fragment which has occupied a rather special niche in Australian scientific literature for about eighty years.

The writer wishes to express thanks to Dr. A. B. Walkom, Director of the Australian Museum, Sydney, for the opportunity of examining the Krefft specimen in detail; to Miss G. D. Walsh for her painstaking work in the illustrations; to P. S. Hossfeld, H. H. Finlayson and Dr. Chas. Fenner for helpful consultation in the preparation of these notes; to Mr. H. M. Hale, Director of the South Australian Museum, for facilities provided in this study.

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EXPLANATION OF PLATE XIV.

Fig. 1.—The Krefft tooth. View of occlusal aspect.

Fig. 2.—Diagrammatic outlines of various aspects of the Krefft fragment.

Fig. 3.—Enlarged diagrammatic outline of the occlusal surface of the Krefft fragment, showing its main features.

Fig. 4.—A, outline of a worn upper right Australian aboriginal molar. B, outline of Krefft fragment continued to represent an upper right molar. C, outline of the Krefft fragment continued to represent a lower left first molar.

Fig. 5.—Occlusal views of: A, the Krefft tooth; B, an Australian aboriginal upper right first molar; C, a modern white upper first right molar.

Text-fig. 1.—Outlines of a series of Australian aboriginal upper right first molars, showing progressive stages of occlusal attrition. O, occlusal; B, buccal; L, lingual.

FIELD NOTES ON THE GREY-TAILED TATTLER.

By J. A. Keast.
The Australian Museum, Sydney.

Habitat-preference amongst the migratory Charadriiformes is an aspect of study to which little attention has been paid in Australia. That these hardy and resolute birds, which bi-annually traverse half the world, should have reached a high stage of adaptability would appear certain. It is therefore surprising to find that some species restrict themselves in their choice of feeding grounds, a differential distribution that has led to a concept of rarity in the case of some comparatively common visitors. Such is the case as regards the Grey-tailed Tattler (*Tringa brevipes*) in New South Wales, as has been shown by observations made during recent years.

The *Official Checklist of the Birds of Australia* (1926) gives the range of the Grey-tailed Tattler in Australia as "Northern Australia, South Queensland, and Western Australia". Actually the species was known from Sydney a quarter of a century previous to this (North, 1898), but it was not until K. A. Hindwood made frequent observations at Long Reef, a rocky promontory near Collaroy, that the species was shown to be a regular summer inhabitant of coastal New South Wales. These and the observations of the writer have shown that the species feeds in small numbers on exposed coastal reefs, but rarely elsewhere, near Sydney. The extensive mud and sand flats along Cook's River and Botany Bay, areas noted for their wader populations, appear to be unsuitable to the Tattlers, and the species has been recorded only once there in one hundred trips spread over six years.* Likewise, it generally avoids sandy beaches and swampy areas. On the other hand, on certain Hunter River mudflats some ninety miles to the north the observations of A. J. Gwynne over a number of years, and of the writer during 1943-1944, have shown that the species occurs in moderately large numbers.

T. brevipes has been recorded from Mud Island, Port Phillip Bay (Bryant, 1933; Anon., 1933; Reed, 1941), and the Swan River (Serventy, 1938) and Rockingham (Sedgwick, 1942) in south-western Australia. There appears to be little doubt that before the southern coastline has been reached the species has thinned out and that it can be regarded as rare there. It is unknown from Tasmania (M. S. R. Sharland, 1945, p. iii).

Status in the Sydney Area.—K. A. Hindwood, who a few years ago (1942, p. 27) summarized his observations of the species at Long Reef between March, 1941, and February, 1942, has kindly made his full notes available for this paper. These show that the species was present on the reef on the four occasions when observations were made there during 1940, 40 of the 47 trips during 1941, 17 of the 19 trips during 1942, the single trip during 1943, four trips during 1944, two trips during 1946, and two trips during 1947. Single birds were seen on 14 occasions, two birds 21 times, three birds 21 times, four birds six times, five birds twice, six-seven birds four times, and twice "several" were recorded. Thus in the majority of instances either two or three birds were present. During the winter months of both 1941 and 1942, when observations were made, the species was present. In 1941 a single bird was present during May, two birds after June 21, three birds after July 14, and four birds after August 24.

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* Strangely enough A. J. North (1898, p. 112) wrote (and referring in error to *T. incana*); "Frequents the flats near the mouth of Cook's River, and the shores of Botany Bay during October and November."

On September 21 the number fell to two, and from then and throughout the ensuing summer and autumn either one, two or three birds were present. Generally the number was constant for some weeks at a time. One or two birds were noted during the winter of 1942, and on October 17 the population jumped to "five or six" birds, probably due to augmentation by migrants from the north. The birds that remained during the winter did not assume breeding plumage.

Long Reef is the finest of its kind in the vicinity of Sydney and is the only area where the species has been consistently observed. The writer and A. R. McGill have noted it four times in twenty trips to the reef at Boat Harbour, near Cronulla, over the last five years (one to four birds). On February 6, 1943, the writer counted seven birds on flats adjacent to the mouth of Cook's River; and Hindwood states that he has recorded single birds once each at Curl Curl Lagoon and the Eastlakes Swamp. A single bird was recorded at Tom Thumb Lagoon, near Port Kembla, on January 6, 1946, by N. W. Chaffer, R. P. Cooper, G. Miller and McGill.

With the exception of Tom Thumb Lagoon, these areas and other wader habitats are frequently visited by observers, and the paucity of records, other than from coastal reefs, indicates a strong preference for that habitat in the Sydney area.

Status on the Hunter River.—Observations and counts of birds were made by the author between October 28, 1943, and May 15, 1944, along Throsby Creek, Hunter River. The creek, which was selected because of accessibility, is shallow and joins the river a few miles from its mouth. Mangroves grow in places; at low tide the water retreats to a series of channels, and medial and lateral mudflats are exposed. Here, where the creek is bounded by the suburbs of Carrington and Wickham, the area was much favoured by waders, the Golden Plover (*Pluvialis dominicus*) and the Grey-tailed Tattler being the dominant species. The Tattlers fed at low tide on the open mudflats or amongst shell-covered stones that had been dumped at places along the water's edge as a safeguard against flooding. At high tide the birds assembled in one of two patches of bare mangrove stumps, perching a few feet above the water and excellently camouflaged against the grey wood. The Plovers, for the most part, fed elsewhere but were frequently located at high tide in an adjacent grassy area or with the Tattlers on the mangrove debris.

A specific route, designed to give a complete count of the Tattlers along this waterway was covered at fortnightly intervals over the period. As observations were not commenced until October 28, the date of arrival of the first birds is not known; the maximum spring count was made on November 25, 1943. The population between December and February was relatively constant at 15 to 25, then a steady increase was noted up to April 16, 1944. Despite the limited nature of the survey, it was interesting to note an increase preceding, and a tapering-off following, these maximum populations.

The spring and autumn populations were as follows:

October 28, 1943	about 12	March 30, 1944	20
November 10	30	April 5	30
November 25	100	April 16	60
December 11	35	April 30	34
March 12, 1944	20	May 7	12
March 23	14	May 15	1

In the spring and autumn a considerable interchange of birds appeared to take place, there being marked differences in the plumage patterns of flocks noted on successive visits. Whether this was due to birds arriving from the south or the more probable explanation of an interchange along the river it is difficult to say. The species did not appear to be represented in the vast assemblage that fed at low tide on sandbanks in the main river, but without doubt the vast marshy hinterland held a population. It is worthy of note that, though only on a limited scale, Throsby Creek is a gathering place at migration time and as such is the most southerly area so far recorded.

Plumage Changes.—Tattlers are amongst the most distinctive of the wading birds, although in eclipse plumage it is not considered that the two species, *Tringa brevipes* and *T. incana** could be distinguished in the field (Serventy, 1944). In *T. brevipes* at this time the upper parts are of a soft even brownish-grey, the breast is pale grey, and the throat and abdomen white. The bill is long and dark-coloured; the legs are a distinctive yellow. A black line joins the eye and the bill, throwing a whitish eyebrow into relief. There is no longitudinal wing stripe and the upper tail is of an even grey tone. They are sleek-bodied, and the wings are long and tapering; their height cannot be appreciated until viewed alongside such a bird as the common Sharp-tailed Sandpiper.

In breeding plumage *T. brevipes* develops barring on the breast and flanks only; *T. incana* over the breast and abdomen. So far as is known, *T. incana* is rare in eastern Australia (Serventy, 1944). During these observations no birds which could have been ascribed to the Wandering Tattler were seen; certainly it may have been present in non-breeding plumage, but it is felt that, once development of the breeding plumage commenced, any Wandering Tattler would have been readily identified. For similar reasons the observations of Hindwood are assumed as being referable to *T. brevipes*.

Towards March faint striations began to appear through the greyish face and breast of some birds. By March 23 ten of fourteen birds observed had light but defined striations through the face, less defined on the lower throat, and dark edging to the feathers of the upper breast and flanks. The black marking between the eye and bill appeared more intense than formerly. There was slight variation amongst the various individuals. Other birds showed little change from the eclipse plumage.

On April 5 notes were made on twenty of the thirty birds counted; all showed distinct and fairly uniform assumption of breeding plumage. Generally the facial, neck, breast and flank markings were more pronounced. A typical bird was described thus: Top of head, brownish-grey; whitish flecking on the forehead. Back of head and neck, brownish-grey, merging into flecking on the sides of the neck. Back, rump and upper tail, grey-brown. Eyebrow, white; distinct dark mark from top of bill to eye and darkish line running through eye to side of head, where it merged with other colouring. Striping on lower face and side of head. Upper throat, white; intense striping on lower throat, and merging into barring of breast feathers. Barred markings well defined on breast and flanks, becoming lighter towards abdomen, which was white. Maxilla brownish-black; proximal portion of mandible dull greyish-yellow, distal portion brownish-black.

Of the sixty birds seen on April 16 almost all were in breeding plumage. One bird, however, showed no trace of breeding plumage, and in a couple of others the face was striped, the throat was white and the upper breast greyish and not barred. The majority of the birds complied with this description: Forehead, sides of face, chin and throat striped; barred markings pronounced on upper breast and flanks. The chin is very lightly striped. Upper parts as before, but with the lower feathers of the back, rump, and upper tail coverts narrowly and indistinctly edged white; feathers of outer edges of under tail coverts transversely marked. Black mark extended from end of bill to eye and threw the eyebrow (white with faint streaking through it) into relief. (I do not agree with Hindwood that this eyebrow becomes more white as breeding plumage is assumed; I consider rather that blackening above and below makes the stripe more prominent.) The eyes were jet black and surrounded by a fine whitish orbital ring.

On April 30 four birds of thirty-four lacked any suggestion of breeding plumage; all others had assumed the plumage described under April 16. Of the four, two were the same shade of grey-brown above as the birds in breeding plumage, but two were slightly more brown in colour. Once previously a bird had been noted with this brownish wash on the back; it is suggested that these are individual aberrants rather than *T. incana*, which species is regarded as being more grey than *T. brevipes* (Stickney, 1943).

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* For the purposes of the present paper I have followed the *Official Checklist of the Birds of Australia*, Second Ed. (1926) in regarding these as distinct species.

The twelve birds recorded on May 7 and the single bird that remained on May 15 were in full breeding plumage.

No birds with the whitish back flecking of the immature were detected during this autumn survey.

General Notes.—The Grey-tailed Tattler has several calls, the flight call being reminiscent of that of the Golden Plover. It has the same plaintive tone and when uttered in full can best be described as "Peeep-peeep-pip-pip-peeep", although just two or three syllables are more frequently used. The species is very vocal in flight.

The Tattlers usually fed in parties of up to seven on the open mudflat, and singly or in pairs when amongst stones, where they could only be discerned with difficulty. The species usually fed apart from other waders, apparently due rather to their feeding grounds being disliked by the other species than a desire for isolation on the part of the Tattlers; they were frequently in company with Silver Gulls (*Larus novae-hollandiae*) and White-faced Herons (*Notophoyx novae-hollandiae*), but few sandpipers and plovers ventured on to these flats.

The species is for the most part trusting, and on several occasions, by careful stalking, it was possible to get within twelve feet of individuals, making the use of the 16× telescope unnecessary. However, when in larger parties they are more timid. This was the case prior to migration; then, too, the birds were restless and flew and settled as a flock. Natural enemies were probably few, but on one occasion, when a Black-shouldered Kite (*Elanus axillaris*) appeared, the flock took flight and their powerful wings carried them swiftly over the water. They swept up and down stream within a few inches of the surface and refused to settle until the Kite moved away.

The species was found to gorge freely on the small burrowing Semaphore Crab (*Heloecius cordiformis*). The habit was first detected on March 23, when a small party was observed at the change of tide. Several birds, apparently having finished feeding, were seated on the drying mud with eyes half-closed; another was asleep on one leg. As I focussed on one of the birds running over the mud its neck was suddenly stretched out, its pace quickened, and a small crab, with legs and chelae thrashing, was lifted into the air. The crab was held in the tip of the bill, taken to the water's edge, where it was shaken vigorously, dropped, shaken, and dropped again. Shortly the motions of the crab became less pronounced, and as the bird gulped the morsel down it was apparent that most of the limbs had been removed. The performance was then repeated, and three birds secured five crabs in as many minutes. Always the crabs were taken to the water's edge and washed prior to being eaten. With the hunting so good it was understandable why the majority were sleeping.

Subsequently (April 16) the observations were carried further. On this occasion some twenty birds were feeding on a small muddy "island" at low tide. The legs and chelae were seen to be removed, not by shaking the crab bodily, but by grasping the limbs and shaking until the body flew away, when the bird dashed after the maimed crab and repeated the performance with another limb. Sometimes the crab was thrown up to three feet when the appendage broke. Four or five "shakings" seemed to be sufficient. The bird did not remove all the legs, some of which could be seen as the crab was swallowed. The body casing was definitely not removed. For a time I noted the position of dissection of the crabs and then waded across to the flat, to where the crabs had been carried. Footmarks of a bird bore evidence of many trips to a chosen place, and in three square feet of clear water (half to one inch deep) fourteen chelae and eleven legs were found. The leg remains were of different lengths, some being complete; in others only the distal podomere was present. Footprints showed where the other members of the party had been feeding, and numerous appendages were found scattered throughout the surrounding water. The incoming tide prevented a full count of the number of crabs that had been eaten, but it was obviously large. It was significant that the majority of appendages found were chelipeds, these being the limbs that could do damage to the bird. The birds had apparently swallowed the majority of other appendages.

On this date, too, Tattlers were seen dipping their bills in the mud, apparently searching for worms, and one area of flat, which had been turned over by boys in search of bait, was very popular.

The crab-eating habit of the Grey-tailed Tattler was again encountered in Jacquinot Bay, New Britain, on April 15, 1945, when a bird in breeding plumage was seen to catch and eat a crab in the same way on the shoreline of broken coral. On this occasion, too, appendages were collected, but it was not possible to obtain a complete crab for identification purposes.

Conclusion.—It can be stated that the Grey-tailed Tattler occurs in moderate numbers during the summer in central coastal New South Wales, but has an irregular distribution. Pending further investigation the species can be considered rare south of Sydney; its occurrence is, however, probably determined by suitable feeding areas.

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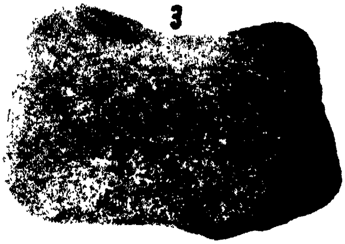
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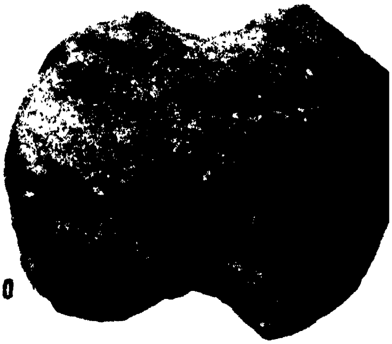
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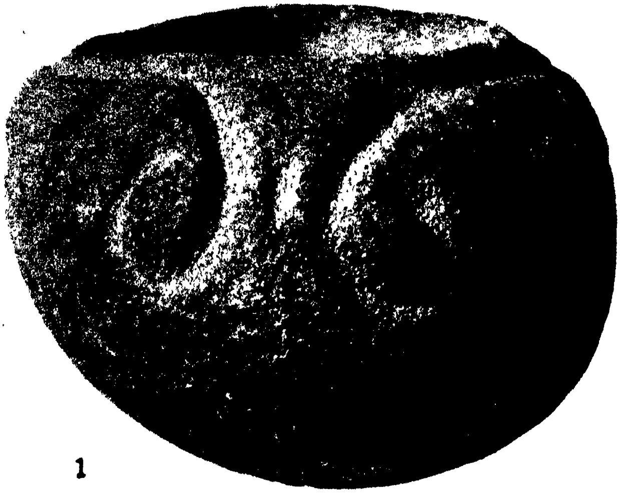

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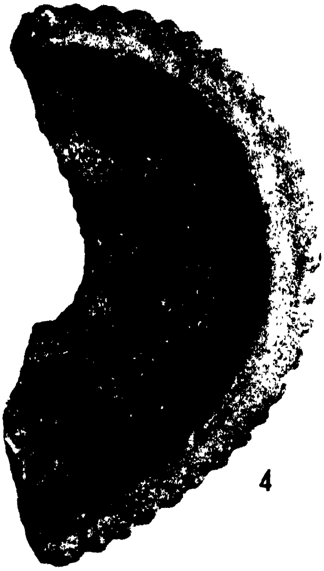

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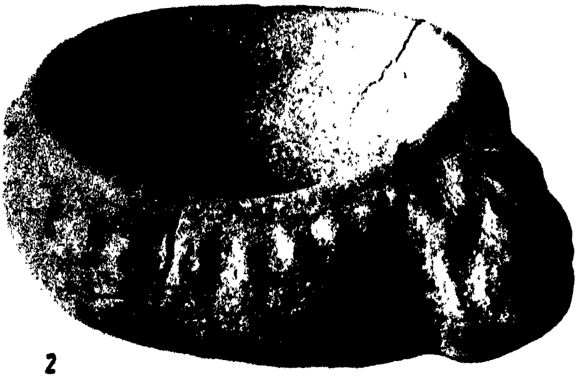

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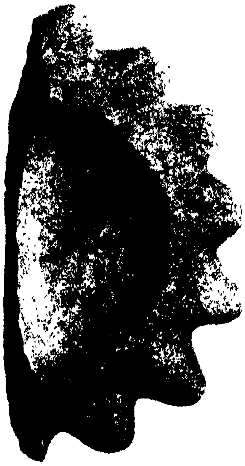

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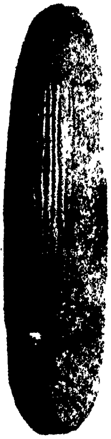
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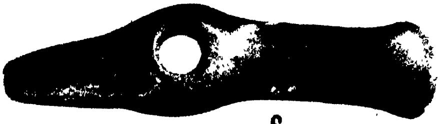
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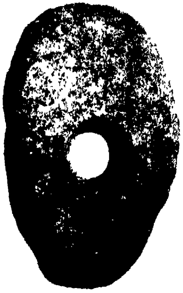
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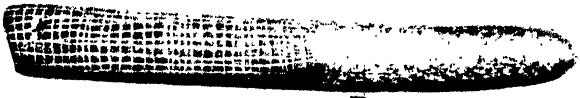
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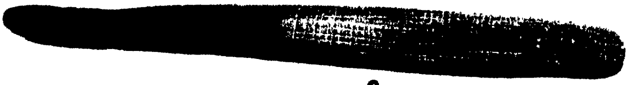
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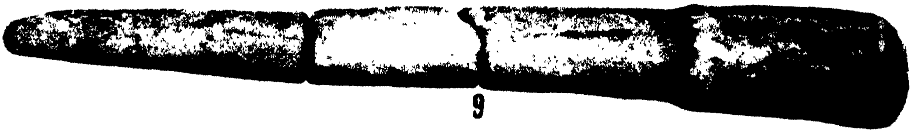
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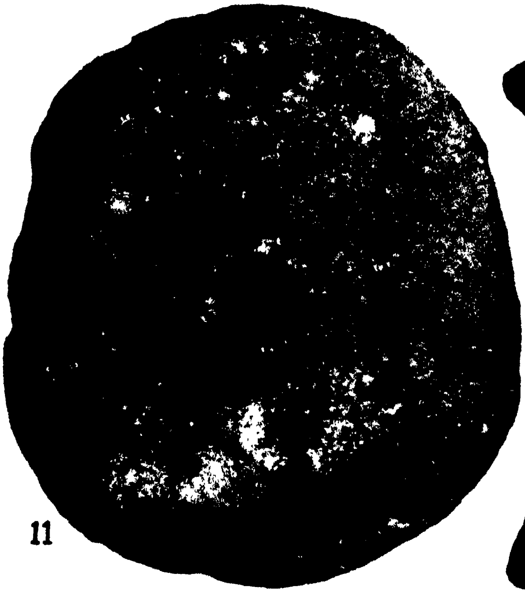
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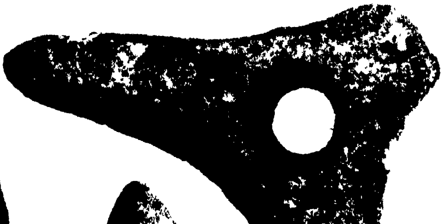
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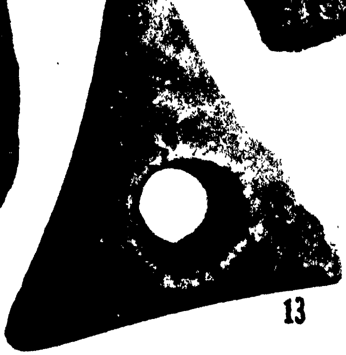
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PLATE X.

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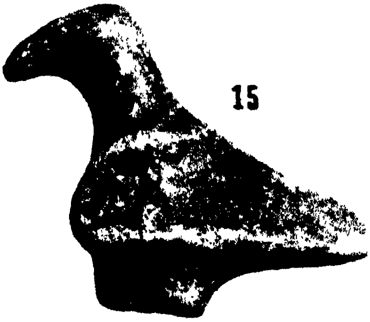
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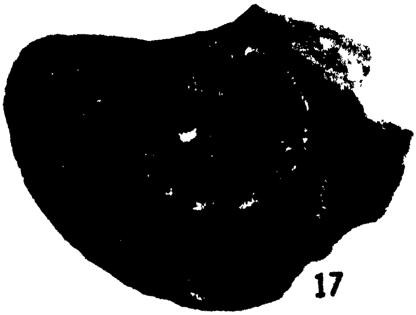
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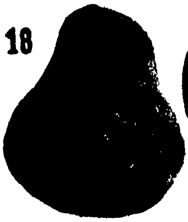
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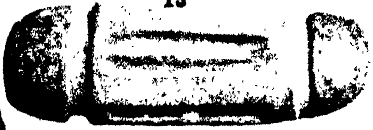
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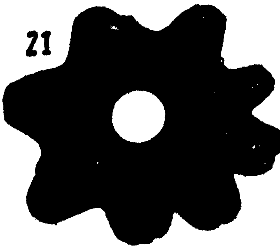
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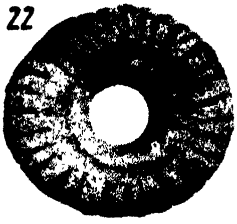
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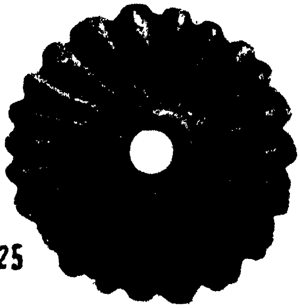
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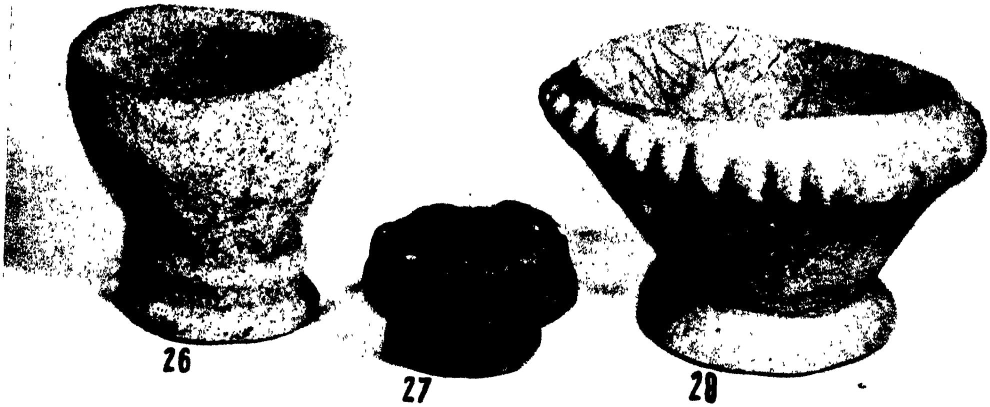
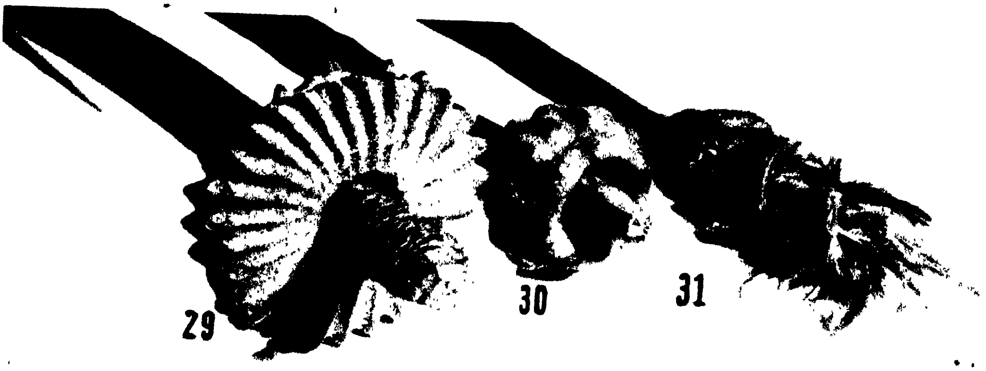
PLATE XI.





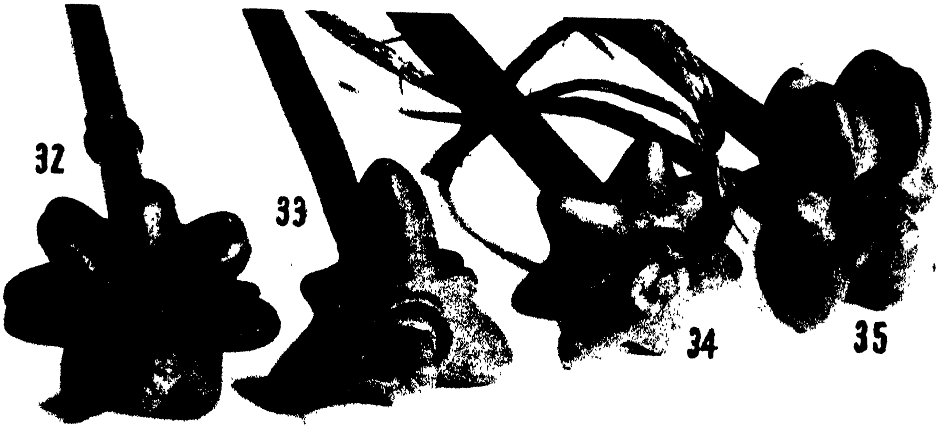
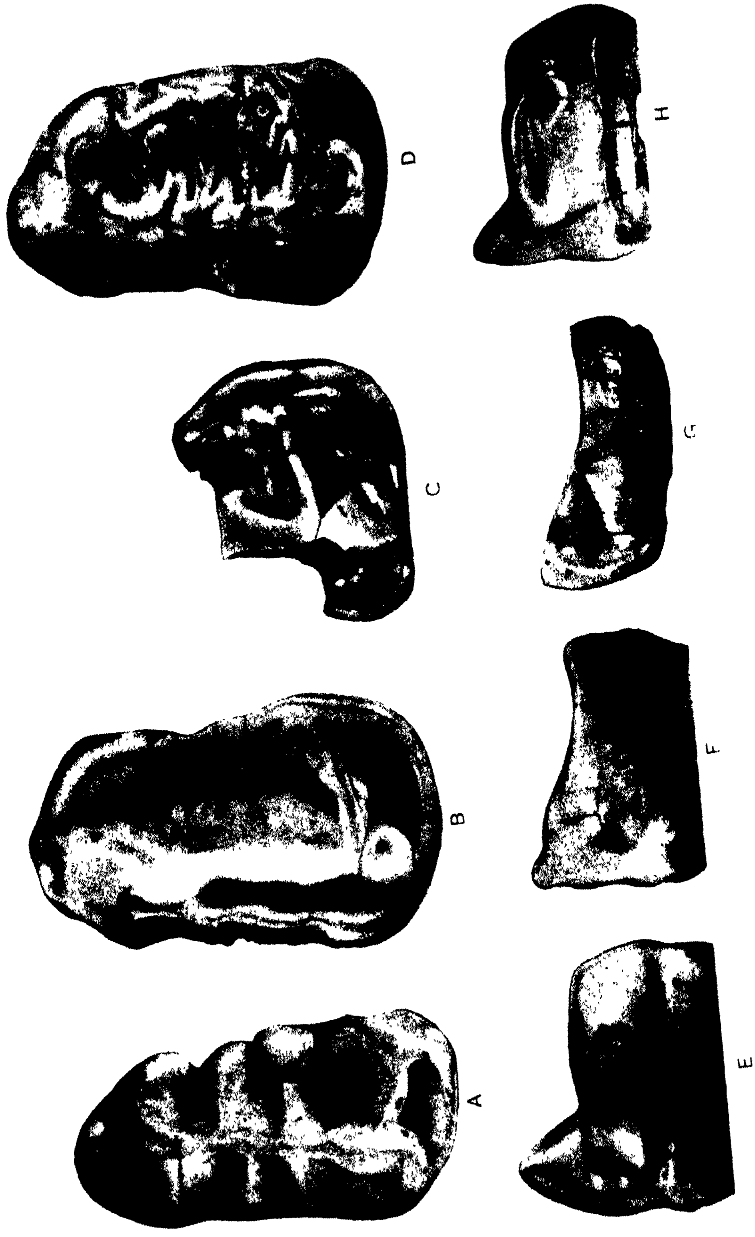
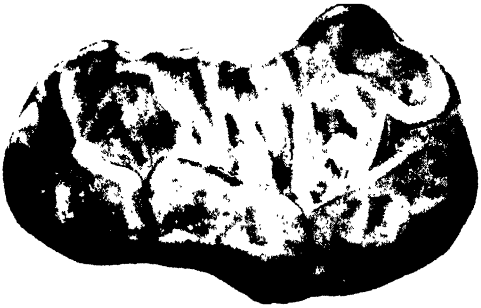
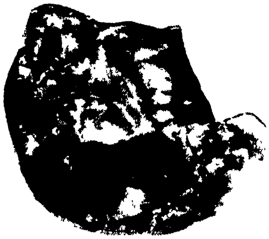


PLATE XII.







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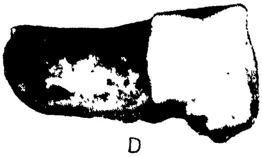

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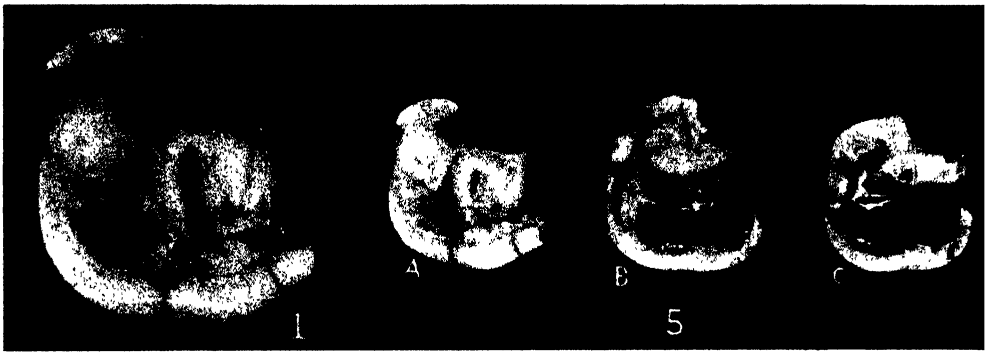
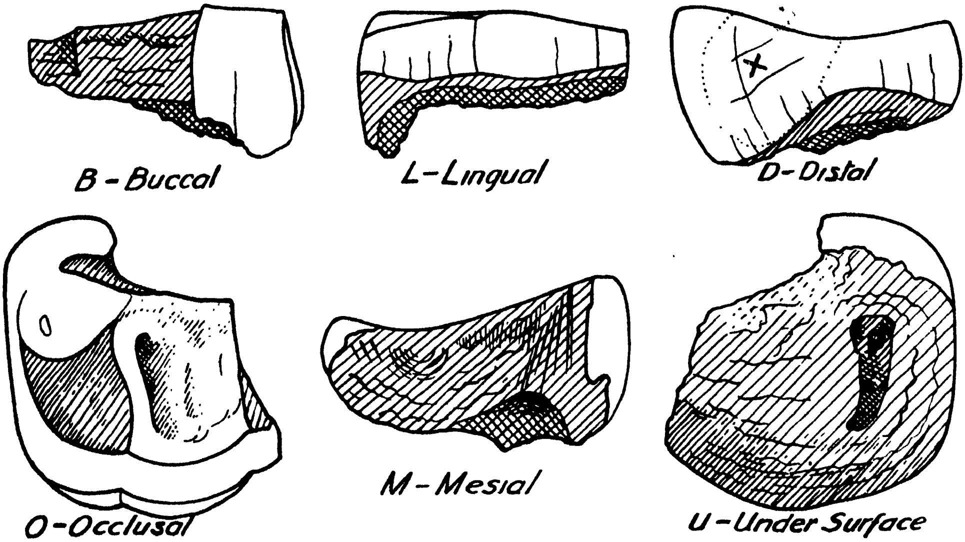
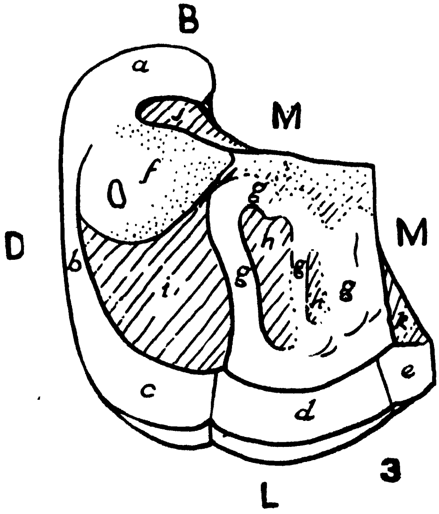




B - Buccal L - Lingual D - Distal

O - Occlusal M - Mesial U - Under Surface



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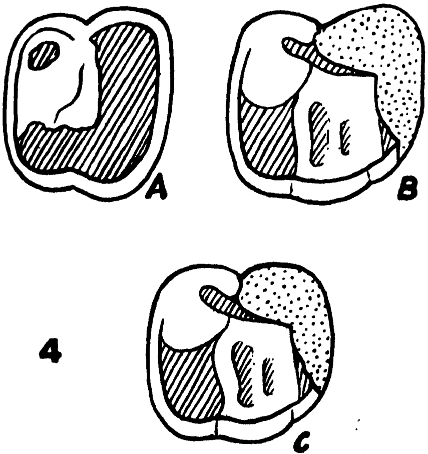

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8 JUN 1950

A SYNOPSIS OF THE HAMMERHEAD SHARKS (*SPHYRNA*), WITH DESCRIPTION OF A NEW SPECIES.

By A. Fraser-Brunner.
British Museum (Natural History).

(Figures 1–3.)

While working upon material obtained recently in the Gulf of Aden I found it necessary to examine the collection of Hammerhead Sharks in the British Museum (Nat. Hist.). The results of this study were somewhat surprising and have necessitated the publication of this paper.

During my work in the field I distinguished three species which I named *Sphyrna zygaena*, *S. mokarran* and *S. tudes*, in accordance with the previously accepted definitions of these forms, but it now appears that not one of these names was correctly applied. The position can best be made clear by discussing briefly each of these in turn.

(*a*) *Sphyrna zygaena*.—It has been shown by Springer that under this name two quite different species have been confused, and he has proposed the name *S. diplana* for the one having a median indentation in the snout, short narial grooves, and other characters. More recently Bigelow and Schroeder, in their fine monograph of the Sharks of the western North Atlantic, have presented a large amount of data upon both species which leaves no doubt as to their distinctness and makes comparative work simple.

The bulk of the material labelled "*S. zygaena*" in our collection proved to agree with the description of "*S. diplana*" and so far from being simply an Atlantic species, as the American authors seem to have supposed, it appears to be circumtropical. We have specimens from Panama, West Indies, Rio Grande, Mediterranean, West Africa, Nigeria, Zanzibar, Seychelles, Aden, Canara, Moluccas, Japan, Formosa, China and Honolulu, none of which differs in any important respect from those described by Bigelow and Schroeder.

In one way this is very unfortunate, because the species occurs off Australia, whence it was described in 1822 by Griffith as *Zygaena lewini*. The original description is almost worthless, but the illustration leaves no doubt that it represents the shark later described and figured more accurately by Whitley. Comparison of the latter with our material and the American descriptions reveals no essential difference between the two forms.

When describing his *S. diplana*, Springer applied the name *S. lewini* to a specimen taken off California in order to show differences between the two. It must be pointed out, however, that some of the minute differences noted may well be due to error. For example, in his best description of the species Whitley (1934) makes no mention of serrated teeth, and in fact shows them in his illustration as entire. His remark in a later work that "the teeth which are entire in the young become finely denticulated" is evidently based on observation of larger specimens for the identity of which we have no evidence. In fact, the photograph which accompanies his comments shows what appears to be a large *S. tudes*, in which the teeth would be serrated. His statement is accompanied also by remarks concerning the alleged lengthening of the narial grooves with age, and proportional differences, which further suggest confusion with other species.

The Californian specimen discussed by Springer had "heavy, serrated teeth" and lacked a median fenestra in the rostral cartilage. This, in my view, rules out the possibility that it could have been *S. lewini*, for all our specimens have smooth-edged teeth and the rostral fenestra is discernible by holding the specimens to the light. Incidentally, as far as our material shows, only those species in which the snout has no median emargination lack the fenestra (*S. tiburo*, *zygaena* and *media*).

Whatever the Californian specimen may have been, therefore, it seems necessary to regard *S. diplana* as a synonym of *S. lewini*.

Of the true *S. zygaena* all our material is from the Atlantic, except for one specimen from Japan, and it is very likely that it does not occur in the Indian Ocean.

(*b*) *Sphyrna mokarran*.—It would seem that no separate species to which the name *S. mokarran* is applicable can be recognized. Reference to the original description and figure and subsequent literature, together with my notes and sketches made in the Gulf of Aden, lead me to the conclusion that *S. mokarran* should be considered a synonym of *S. tudes* as defined by Bigelow and Schroeder. In the Gulf of Aden, as in the Atlantic, this grows larger than the other species and is well named the Great Hammerhead.

(*c*) *Sphyrna tudes*.—The specimens which I noted under this name in the field, and some of the material labelled thus in the British Museum, prove to be very different from *S. tudes* as recognized above. Among the specimens originally described by Valenciennes were two from the Atlantic and one from Coromandel; it is clear that the latter (the head of which he figured) represented the species now under consideration, which cannot bear the name *tudes* because this has been taken, by common agreement, to apply to the Atlantic specimens. It appears, therefore, that Valenciennes' Coromandel example, some of our Old World material and a number of records in the literature should be associated with *S. oceanica* Garman.

To sum up this discussion:

(*a*) *Sphyrna diplana* Springer, 1940 = *S. lewini* (Griffith, 1834).

(*b*) *Sphyrna mokarran* (Rüppell, 1835) = *S. tudes* (Valenciennes, 1822, *part*).

(*c*) *Sphyrna tudes* (Valenciennes, 1822, *part*) = *S. oceanica* (Garman, 1913).

One more point needs to be elucidated before giving a synopsis of the whole genus. The specimen described by Fowler, 1941, from Richmond River, New South Wales, as *S. lewini* certainly is not that species. Springer seems to have thought it to be *S. mokarran*, which is considered here to be a synonym of *S. tudes*, but although it is admittedly closely related it seems to be a different species. This opinion I base partly on Fowler's description and figure (which unfortunately are not in complete agreement), but more especially on a specimen in our collection from Clarence River, New South Wales, which can be identified with reasonable certainty with Fowler's example. This species requires a new name and is now described.

Sphyrna ligo, sp. nov. (Figure 1.)

Head moderately expanded laterally, the posterior margin of the expansion much shorter than the width behind the nostril. Length of snout contained three and one-eighth times in greatest width of head. Front margin of snout doubly convex, a distinct median indentation; no distinct notch before nostril. Hind edge of lateral expansion of head roughly parallel with front edge, the outer angles posterior to corners of mouth. Outer narial groove scarcely developed, inner groove not at all. Eye moderate, its diameter equal to its distance from nostril. Length of head, measured to upper end of last gill-opening, contained three times in length of shark measured to caudal pit. Pectoral fin commencing a little anterior to fourth gill-slit, the length of its base four and a quarter in length of head, its front margin more than twice as long as its base, four times as long as its hind margin, one and three-quarter times as long as its distal margin, which is concave.

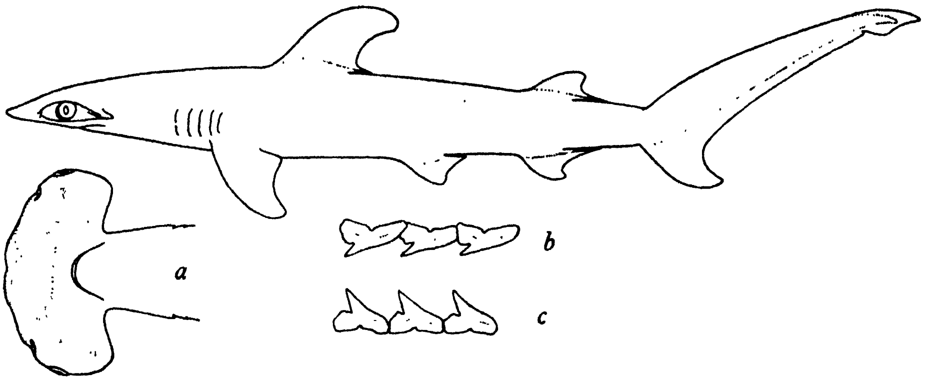

Figure 1. *Sphyrna ligo*, sp. nov. Holotype. *a*, ventral view of head; *b*, upper, and *c*, lower teeth.

A. Fraser-Brunner del.

First dorsal fin commencing well behind axil of pectoral, but not as far back as hind angle. Base of dorsal fin contained three and a quarter times in length of head, one and a third times as long as pectoral base; front margin of fin curved, about one and a quarter times as long as that of the pectoral, its tip broadly rounded, its distal margin deeply concave, forming pointed hind lobe with hind margin, which is one-third length of base of the fin. Distance from axil of pectoral to axil of pelvic somewhat less than distance from tip of snout to origin of pectoral. Base of pelvic about equal to that of pectoral, shorter than its front margin and twice as long as its hind margin; distal margin slightly concave. Distance from axil of pelvic to origin of anal twice length of anal fin, which is a little shorter than that of the pectoral. Front margin of anal fin a little longer, hind margin a little shorter, than the base; distal margin concave; posterior pointed lobe reaching half-way from base of fin to caudal pit. Base of second dorsal fin a little longer than that of anal, commencing somewhat farther back; its front margin much longer than its hind margin; distal margin deeply concave; posterior pointed lobe reaching half-way from base of fin to caudal pit.

Caudal fin (measured from caudal pit to tip) equal to distance from tip of snout to posterior angle of pectoral, or two and a third times in length of body; lower lobe shorter than pectoral.

Teeth at sides of both jaws oblique, outer edges forming deep notch; lower cusps somewhat larger and more erect; four or five smaller erect teeth in middle of each jaw.

Underside of head with mucous pores arranged in patches as shown in the figure.

Described from the holotype, a specimen 325 mm. from tip of snout to caudal pit, from Clarence River, New South Wales.

Closely related to *S. tudes*, from which it differs in having the eyes somewhat farther from the nostrils, the mouth farther forward, first dorsal fin more posterior, and the relationship of the second dorsal and anal different.

The head is reminiscent of a Dutch hoe rather than a hammer, hence the name (Lat. *ligo*, a hoe).

The Sphyrnidae seem to differ from the Carcharhinidae mainly in the lateral expansion of the head, and the evolution of this curious development is illustrated quite well among the known species, as will be seen by reference to Figure 2 and the key.

The least aberrant form is *S. tiburo*, having the head comparatively little expanded, the snout evenly rounded and no extended narial grooves; related to this is *S. media*, in which the head is much wider. From this point we must recognize a divergence. On one hand is *S. zygaena*, in which the head is more greatly expanded, with a consequent drawing out of the narial apparatus, as it were. On the inner side

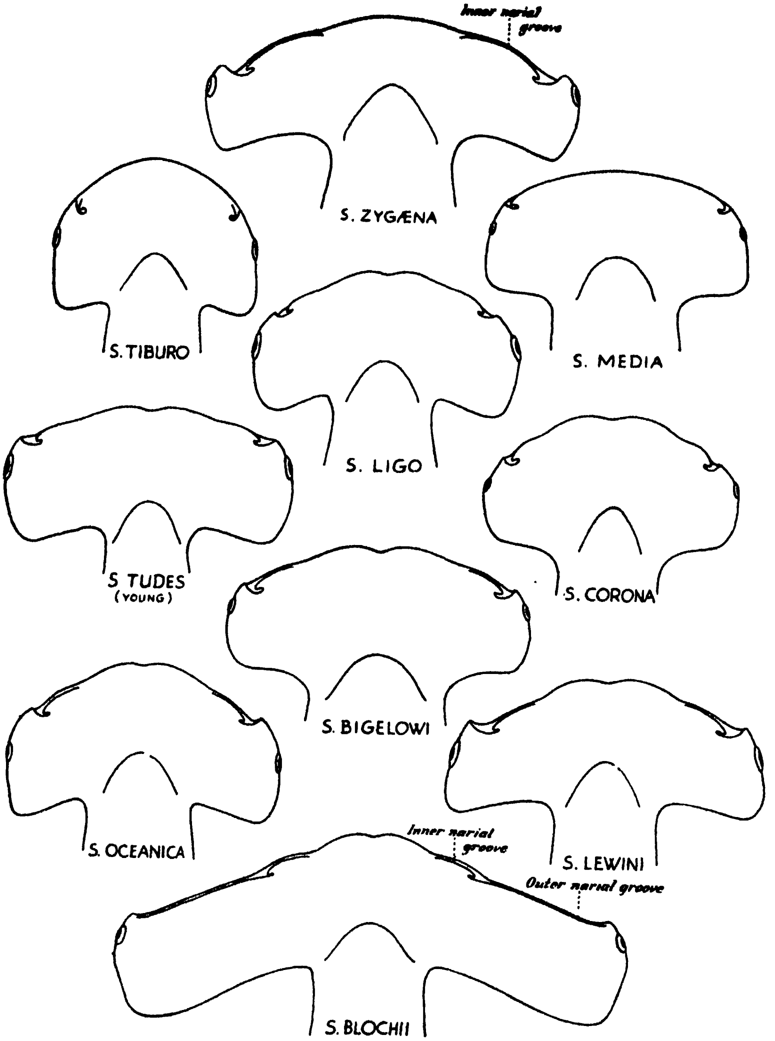

Figure 2. Lower view of heads of Hammerhead Sharks. Where narial grooves are present they are shown, for clarity, a little more ventral than they actually are.

A. Fraser-Brunner del.

of the nostril, extending towards the middle of the snout, is the "inner narial groove", longer in this than in any other species. On the outer side a slight extension of the nasal opening shows the beginning of an "outer narial groove". But in this form the profile of the snout retains its original rounded form.

Along another line from *S. tiburo* we find a more gradual widening of the head, at first without extended inner grooves (*S. ligo, tudes, corona*), then with the grooves distinct (*bigelowi, oceanica, lewini*), and in all these there is a distinct emargination in the middle of the profile of the snout.

In *S. lewini* there is the beginning of an external narial groove, and from this form we can derive, by a rather sudden jump, the extraordinary *S. blochii*, in which the lateral expansion carries the eye far from the nostril, with a consequent extension of the outer narial groove that is far greater than that of the inner one. It will be obvious by a comparison of the figures given that without the extension of the outer narial region the head of *S. blochii* would be almost exactly like that of *lewini*; the two also resemble each other in the proportions of the fins, and especially in the second dorsal point reaching farther back than in the rest.

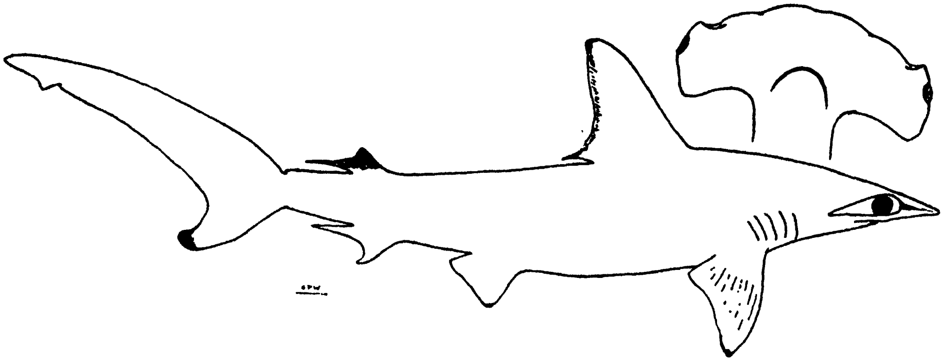

Figure 3. *Sphyrna lewini* (Griffith). Immature female, 55 cm. from snout to caudal pit, from Menapi, Goodenough Bay, Papua.

G. P. Whitley del.

If subgenera are to be recognized in this group, they can best express the relationship if applied to *S. zygaena* (*Sphyrna*), to the *tiburo-media* group (*Reniceps*), to the *tigo-lewini* complex (*Platysqualus*), and to *S. blochii* (*Eusphyra*).

Key to the Species of Sphyrna.

I. Outer narial grooves not extensive; eye not more than twice its diameter from the nostril.
  A. Inner narial groove extending more than half-way to middle of snout (total narial length contained one and a half times or less in internarial width). Front of snout, viewed from above, convex, without median indentation; no median fenestra in rostral cartilage. Base of anal fin much shorter than that of pectoral, about equal to base of second dorsal (*Sphyrna* Rafinesque, 1810).
    Anterior edge of second dorsal shorter than its posterior pointed lobe, which reaches half-way from base of fin to caudal pit. First dorsal and pectoral fins subequal .... 1. *zygaena*.
  B. Inner narial grooves, when present, extending less than half-way to middle of snout (total narial length contained twice or more in internarial space). Base of anal fin at least as long as that of pectoral.
    1. Inward extension of narial groove inconspicuous or absent.
      a. Front margin of snout convex, without median indentation; rostral cartilage without median fenestra. Origin of first dorsal fin above hind angle of pectoral. First dorsal and pectoral fins subequal. Base of second dorsal much shorter than that of anal (*Reniceps* Gill, 1862).
        i. Head shovel-shaped, the length of snout contained much less than three times in greatest width of head. Hind angles of lateral expansion of head posterior to corners of mouth. Anterior edge of second dorsal longer than hind lobe, which reaches two-thirds distance from base of fin to caudal pit .... 2. *tiburo*.
        ii. Head broader, length of snout contained three times or more in width of head. Front and hind margins of lateral expansions of head converging, the hind angles anterior to corners of mouth. Anterior edge of second dorsal fin about as long as the hind lobe .... 3. *media*.
      b. Front margin of snout double-convex, a distinct median indentation; rostral cartilage with median fenestra.* First dorsal fin much larger than pectoral, its origin anterior to hind angle of pectoral (*Platysqualus* Swainson, 1839).
        i. Hind angle of lateral expansion of head posterior to corners of mouth. Eye distant from nostril by at least its own diameter. First dorsal fin commencing well behind axil of pectoral. Base of second dorsal a little longer than that of anal, but somewhat behind it. Base of anal a little shorter than that of pectoral. Pointed hind lobe of second dorsal reaching half-way from base of fin to caudal pit .... 4. *tigo*.

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* Not verified in *S. corona*.

ii. Hind angle of lateral expansion of head anterior to corners of mouth.

a. Front and hind margins of lateral expansions of head roughly parallel. Eye distant from nostril by less than its own diameter. First dorsal fin commencing above axil of pectoral. Base of second dorsal a little shorter than that of anal, ending above it. Base of anal somewhat longer than that of pectoral .... 5. *tudes.*

β. Front and hind margins of lateral expansions of head converging, head roughly oval. Eye distant from nostril by more than its own diameter. Base of second dorsal less than half length of that of anal. Base of anal twice length of that of pectoral .... 6. *corona.*

2. Inward extension of narial groove distinct, deep, extending less than half-way to middle of snout. Front profile of snout double-convex, a distinct median indentation present.

a. Front and hind margins of lateral expansions of head converging, the hind angles far in advance of corners of mouth. Eye small, distant from nostril by about its own diameter. First dorsal originating somewhat behind axil of pectoral; these fins subequal. Base of second dorsal fin half (or less) length of that of anal, ending above it. Base of anal fin much longer than that of pectoral. Anterior edge of second dorsal as long as, or longer than, hind lobe, the point of which reaches two-thirds of the way from fin base to caudal pit .... 7. *bigelowi.*

b. Front and hind margins of lateral expansions of head roughly parallel, the hind angles posterior to corners of mouth. First dorsal fin much larger than pectoral. Base of second dorsal fin much shorter than that of anal, which equals pectoral base.

i. Eye small, distant from nostril by twice its diameter or more. Length of snout contained three times in greatest width of head. First dorsal origin above axil of pectoral. Front edge of second dorsal shorter than the posterior lobe, the point of which reaches two-thirds of the distance from fin base to caudal pit .... 8. *oceanica.*

ii. Eye larger, distant from nostril by its own diameter or less. Length of snout contained about four times in width of head. First dorsal origin somewhat behind axil of pectoral. Front edge of second dorsal fin shorter than hind lobe, the point of which reaches nearly to caudal pit .... 9. *lewini.*

II. Outer narial grooves greatly extended along much produced lateral expansions of head, the eye distant from the nostril by many times its diameter (*Eusphyra* Gill, 1862). Head otherwise much like that of *S. lewini.* First dorsal fin much larger than pectoral, its origin somewhat behind axil of pectoral. Base of second dorsal much shorter than that of anal, ending behind it; front margin of fin about equal to hind lobe, point of which reaches nearly to caudal pit. Base of anal equal to that of pectoral .... 10. *blochii.*

The species thus defined are listed below, with such references to literature as will help to clarify their status; but it has not proved possible for me to determine the true identity of many of the Old World records, a task which must be left for a later occasion.

1. *Sphyrna zygaena* (Linnaeus, 1758).

For synonymy and references see Bigelow and Schroeder, 1948, Mem. Sears Found. Mar. Res. no. 1, pt. 1, p. 436, fig. 85.

Hab.—Coasts of Atlantic Ocean; Mediterranean; eastern Pacific Ocean; Japan.

2. *Sphyrna tiburo* (Linnaeus, 1758).

For synonymy and references see Bigelow and Schroeder, 1948, *loc. cit.*

Hab.—Coasts of Atlantic Ocean; eastern Pacific Ocean.

3. *Sphyrna media* Springer, 1940.

Sphyrna media Springer, 1940, Stanford Ichth. Bull. i, no. 5, p. 162, fig. 3.

Hab.—Pacific coast of Mexico and Panama.

4. *Sphyrna ligo*, sp. nov. (p. 214).

Sphyrna lewini Fowler, 1941, Bull. U.S. Nat. Mus., 100, xiii, p. 215, fig. 9 (not of Griffith).

Hab.—New South Wales.

5. *Sphyrna tudes* (Valenciennes, 1822).

Zygaena tudes Valenciennes, 1822, Mem. Mus. Hist. nat. Paris, p. 225 (*part.*).

Zygaena mokarran Rüppell, 1835, Neue Wirbelth. Fische, p. 66, pl. xvii, fig. 3.

Zygaena dissimilis Murray, 1887, Journ. Bomb. Soc., ii, p. 103 and pl.

Sphyrna mokarran Fowler, 1941, Bull. U.S. Nat. Mus., 100, xiii, p. 214 (Indo-Pacific references).

Sphyrna tudes Fowler, 1941, *loc. cit.*, p. 213 (Indo-Pacific references); Bigelow and Schroeder, 1948, Mem. Sears Found. Mar. Res., no. 1, pt. 1, p. 428, figs. 83–84.

Hab.—Circumtropical.

6. *Sphyrna corona* Springer, 1940.

Sphyrna corona Springer, 1940, Stanford Ichth. Bull., i, no. 5, p. 163, fig. 4.

Hab.—Panama.

7. *Sphyrna bigelowi* Springer, 1944.

Sphyrna bigelowi Springer, 1944, J. Wash. Acad. Sci., xxxiv, p. 274, ill.; Bigelow and Schroeder, 1948, Mem. Sears Found. Mar. Res., 1, pt. 1, p. 410, figs. 79–80.

Hab.—Atlantic coasts of South America (specimens from British Guiana in Brit. Mus.).

8. *Sphyrna oceanica* Garman, 1913.

Zygaena tudes Valenciennes 1822, Mem. Mus. Hist. nat. Paris, p. 225 (*part.*), pl. 12, fig. 1; Günther, 1870, Cat. Fish. Brit. Mus., viii, p. 382 (*part.*); Day, 1878, Fishes of India, pt. 4, p. 720, pl. 188, fig. 4; and later authors (*part.*).

Cestracion oceanica Garman, 1913, Mem. Mus. Comp. Zool., xxxvi, p. 158.

Sphyrna tudes Fowler, 1941, Bull. U.S. Nat. Mus., 100, xiii, p. 213 (Indo-Pacific references *part.*).

Hab.—Indo-Pacific (specimens from Gulf of Aden, Sumatra and Marquesas Is. in Brit. Mus.).

9. *Sphyrna lewini* (Griffith, 1834).

Zygaena lewini Griffith, 1834, Animal Kingdom Cuv., x, p. 640, pl. 50.

Sphyrna lewini Whitley, 1934, Mem. Queensl. Mus., x, pt. 4, p. 192, pl. xxviii.

Sphyrna zygaena Fowler, 1941, Bull. U.S. Nat. Mus., 100, xiii, p. 217 (Indo-Pacific references).

Sphyrna diplana Springer, 1940, Proc. Florida Acad. Sci., v, p. 46, figs. 1, 2; Bigelow and Schroeder, 1948, Mem. Sears Found. Mar. Res., 1, pt. 1, p. 415, fig. 81 (Atlantic references).

Sphyrna lewini Whitley, 1948, Austr. Zool., xi, p. 262, pl. xxiv, and figs. 3-4; 1949, Austr. Mus. Mag., ix, p. 345.

Hab.—Circumtropical.

10. *Sphyrna blochii* (Cuvier, 1817).

Zygaena blochii Cuvier, 1817, Regne Anim., ii, p. 127.

Zygaena platycephalus Van Hasselt, 1823, Algem. Konst. Letterb.

Zygaena laticeps Cantor, 1837, Quart. Med. J. Calcutta, p. 315, pls. 1–3.

Sphyrna blochii Fowler, 1941, Bull. U.S. Nat. Mus., 100, xiii, p. 221 (full references).

Hab.—Indo-Pacific.

TRILOBITES FROM THE SILURIAN OF NEW SOUTH WALES.

By H. O. Fletcher.
Curator of Palaeontology, The Australian Museum.

(Plates xv–xvi.)

In this paper three new species of trilobites are described from a Lower Silurian horizon at Borenore, near Orange, New South Wales, as *Encrinurus borenorensis*, *Phacops macdonaldi* and *Dicranogmus bartonensis*. The genus *Encrinurus* Emmrich, 1844, is discussed and it is considered that the genus *Cryptonymus* Eichwald, 1825, is an abandoned name and cannot be used outside certain limits. Reference is made to the recorded Australian species of the family Lichidae and their geological age.

The fossil material was originally found and forwarded to the Australian Museum by Mr. George McDonald, of "Rosyth", Borenore, on whose property the new horizon of fossils is situated. The author visited the locality later and collected additional specimens of all the described species. My thanks are due to Mr. McDonald for his assistance and interest, which have made possible the preparation of this paper. I am also indebted to Mr. F. Booker and Mr. L. Hall, of the Geological Survey of New South Wales, for assistance in determining the geological succession of the area.

The trilobite remains are not well preserved and in not one instance was a complete specimen collected. Conditions for their preservation must have been most unfavourable, and it appears as if the trilobites were transported some distance before burial, as the fragmentary remains are found closely packed together in definite zones. The specimens are represented by numerous head-shields and pygidia but, although an intensive search was made, no thoracic segments were found.

STRATIGRAPHICAL NOTES.

The fossil beds are exposed on Portion 292, Parish of Barton, County Ashburnham. They are Lower Silurian in age and the sequence consists of limestones, shales, and dacitic tuffs. The basal limestone in the area is richly fossiliferous and contains an abundant coral fauna in which the genus *Halysites* predominates. Overlying this coralline limestone is approximately 190 feet of non-fossiliferous shales, while overlying this again is a thin band of ferruginous shales, a small exposure of which contained a trilobite fauna consisting mainly of the genera *Encrinurus*, *Phacops* and isolated fragmentary remains of the family Lichidae. Very occasional brachiopods and corals are also found in this horizon.

At the top of the sequence of rocks in this area is a crinoidal limestone, approximately 380 feet in thickness, in which the genus *Halysites* has not been found.

The geological sequence is as follows:

Lithology.	Thickness in feet.
Crinoidal limestone	380
Dacitic tuff	130
Shales and tuffs	330
Ferruginous shale with trilobites	20
Shales	190
Coralline limestone with *Halysites*	260

These Silurian rocks are the northerly extensions of the horizons tabulated by Sussmilch (1906, pl. xviii) and Sussmilch and Jensen (1909, p. 159).

Sussmilch (1906, pp. 131–2) recorded a coralline limestone about twenty feet in thickness outcropping close to the junction of Spring and Gap Creeks. It was traced to the north-west for a short distance towards the junction of Spring and Quarry Creeks. In this coralline limestone the corals are completely silicified and are beautifully preserved. It contains a most characteristic coral fauna in which the genus *Halysites* is abundant, being represented by six species.

A second limestone horizon was mapped by Sussmilch about four miles to the north-east of the coralline limestone in portions 156, 196, 180, 136, Parish of Barton. This limestone horizon, referred to by Sussmilch as a crinoidal limestone, attains a thickness of at least 400 feet and is built up mainly of crinoid stems and brachiopods with a fair proportion of corals. Three species of trilobites are recorded from this limestone: *Bronteus*, sp. indet.; *Calymene*, sp. indet.; and *Encrinurus* ?, sp. indet.

No additional information was published in regard to the Silurian rocks of this area by Sussmilch and Jensen in 1909, with the exception of a revised list of Silurian fossils. In this list the genus *Encrinurus*, doubtfully recorded from the crinoidal limestone by Sussmilch in 1906, was omitted.

The two limestone horizons outcropping on portion 292 at Borenore can be correlated with those recorded by Sussmilch from the vicinity of Gap and Spring Creeks and at Oakey Creek, in the country west of the Canobolas.

In both areas the coralline limestone beds, although varying a great deal in thickness are characterized by possessing a rich *Halysites* fauna and must represent the one horizon. At Borenore the basal bed of the sequence is the coralline limestone with overlying dacitic tuffs, at the top of which is found the ferruginous shale containing *Encrinurus* and *Phacops* in abundance. Sussmilch did not apparently find this particular trilobite horizon in the area west of the Canobolas and not a great distance south of its occurrence at portion 292, Borenore. He did record a thin band of red shales, about forty feet in thickness, in the succession of strata along Oakey Creek in portions 249, 136, etc., but this bed overlies the crinoidal limestone and is apparently unfossiliferous.

Further field work is necessary in this area before any definite correlations can be made between the complete sequence of rocks on portion 292 and those recorded and mapped by Sussmilch. There are discrepancies in the two successions, although the distance between the two areas is only between four and six miles.

The trilobite and coral fauna found in these rocks indicates a Lower Silurian age. The only published record of *Halysites* in the Yass district is H. *pycnoblastoides* Eth., from the Bango Series of the Lower Silurian, the type locality of this species being the coralline limestone at Spring Creek, portion 221, Parish Barton. In recent years it has been found that *Halysites* is not an uncommon genus in the Bango Series and this occurrence can be correlated with the *Halysites* horizon at Borenore. The Bango Series is below the Hume Series in the Yass area, in which is found a rich trilobite fauna in the Lower, Middle and Upper Trilobite Beds. Above the Middle Trilobite Bed is the Monograptus Bed, the fauna of which indicates in the English Silurian sequence an age equivalent to the top of the Wenlock and the base of the Lower Ludlow. The complete Hume Series is considered by Ida Brown (1941, p. 335) to be of Upper Silurian age.

NOTES ON THE GENUS ENCRINURUS

After a most comprehensive examination of the family Encrinuridae, Cowper Reed (1928, p. 51) came to the conclusion that it contained the genera *Ectenonotus*, *Encrinurella*, *Cybele*, *Dindymene*, *Encrinurus* and *Cybeloides*. These genera have distinctive features, with the exception of *Encrinurus*, where there has been some controversy regarding the limits of its generic characters.

It is pointed out by Reed that the genus *Encrinurus* as instituted by Emmrich (1844, p. 16) would restrict to that genus those species having "the genal angles of the head produced into spines, the pygidium with a many-jointed axis terminating in a long caudal spine or blunt point, with 9–10 pleurae".

The generic name *Cryptonymus* of Eichwald (1840, p. 71) was re-introduced by Vogdes (1907, p. 63) to include those species of *Encrinurus* in which the genal angles of the head are not produced into spines after the type of *E. variolaris* Brongn. His diagnosis of the genus is "Head shield semi-circular; genal angles rounded, not produced into spines. Glabella gibbous and overhanging, with obscure furrows. Eyes prominent, smooth. Thorax with eleven segments; pleurae without grooves, notched at ends. Pygidium triangular; convex and rounded at the end, with 9–15 (axial) joints and few pleurae (seven or more)."

The main points of difference, therefore, between *Cryptonymus* and *Encrinurus* are the character of the genal angles and the termination of the pygidium. Vogdes also defined the characters of *Encrinurus* as including 18–23–30 joints in the axis of the pygidium, the centre of which is marked by a single row of nodes.

This division into the above two groups was not generally accepted by later workers. Weller (1907, p. 157) defined the genus *Encrinurus* in such a way that it included species with or without genal spines, and he made no reference to the nodular arrangement found on the pygidium.

The genus *Cryptonymus* has been referred to a great deal as far as the Silurian trilobites of Australia are concerned. Mitchell (1924, p. 46) introduced the genus to include several known species of *Encrinurus* and a number of his new species. In his previous paper on the family Encrinuridae, written in collaboration with Etheridge (1915, p. 646), the genus *Cryptonymus* was not mentioned.

In 1924 Mitchell proposed that the generic characters of *Encrinurus* should remain as already recognized, that is, the genal angles could be produced into spines or else rounded. He thought, however, that the genus *Cryptonymus* should be recognized on pygidial characteristics. The genus would have a head-shield and thorax similar to *Encrinurus*, but its separation from that genus would depend on the presence of continuous axial rings on the pygidium. The species with interrupted or discontinuous axial rings would form the genus *Encrinurus*.

It was pointed out by Reed that this method of classification is doubtfully of any value, as it is more than possible that the non-continuity of the axial rings on the pygidia is of a secondary nature. In some Ordovician species, Reed states, the axial rings consist of both continuous and non-continuous types. However, Reed (1928, p. 66) uses this character to some extent in determining groups within the species of *Encrinurus*.

Etheridge and Mitchell (1915, p. 656) have pointed out that within certain species of *Encrinurus* the axial rings are continuous on testiferous specimens while they are discontinuous and median spaces are developed when the test is not preserved. Unfortunately almost all the specimens of *Encrinurus* found in Australian Silurian rocks are non-testiferous and rarely is one found in which the test is preserved. After an examination of a good deal of material the continuous or discontinuous nature of the axial rings of the pygidium together with the ornamentation of the axis by nodes appears to be a constant specific feature.

The possession of both types is a feature well developed in specimens of *E. borenorensis*, and on well-preserved but non-testiferous examples the axial rings consist of both continuous and broken ones with a median flattened space on which tubercles or nodes may be present or absent. The first six anterior axial rings are continuous and ornamented with tubercles. The seventh and eighth are discontinuous, the median spaces being ornamented by single nodes. On the ninth and tenth the median spaces are smooth. The eleventh and twelfth are more or less continuous with a single central node. The following three are discontinuous with smooth median spaces with the sixteenth and seventeenth complete and a single central node. The eighteenth is incomplete, while the remaining four small axial rings are complete.

The possession of both types of axial rings on the pygidia of *E. borenorensis* is additional evidence in support of Reed's contention that the character of these is of insufficient importance to be used as a generic distinction. It seems better, therefore, to follow the example of authors who have discarded the genus *Cryptonymus* in favour of *Encrinurus*. The distinguishing features which have separated the two genera are not constant or distinctive enough to be of generic importance. The genus *Encrinurus* is one in which we have to accept a considerable amount of variation amongst the many species referred to it. As it stands, the genus is well defined and the species it contains form an easily recognized and compact group.

Of still greater importance, however, is the fact that *Cryptonymus*, according to the rules of nomenclature, must be considered as an abandoned name. Some authors have recognized this fact, while others are of the opinion that the name can still be used. Eichwald (1825, p. 44) instituted this genus to include eight species of trilobites, all of which are now classed as *Asaphus* or *Illaenus*. Vogdes (1907, p. 62) is of the opinion that the genus *Cryptonymus* should stand under the strict rule of priority for at least such species as *Encrinurus punctatus* or *E. variolaris*. This, however, cannot be the case. Not one of the species originally included in the genus *Cryptonymus* of 1825 can be referred to the family Encrinuridae and it was not until fifteen years later that Eichwald (1840, p. 71) included *C. punctatus* and *C. variolaris* in the genus. Vogdes points out that Eichwald was correct in re-introducing his abandoned name in 1840, as he originally only pointed out his generic types without giving a generic description. I am of the opinion that the genus *Cryptonymus* can be used only for any of the original eight species, and the species *Cryptonymus punctatus* and *C. variolaris*, introduced later in 1840, must therefore each be placed as a synonym, *Cryptonymus* (non *Cryptonymus*, 1825) of *Encrinurus* Emmrich, 1844.

Salter (1866, p. 168) used the genus *Cryptonymus* with *Asaphus expansus* as a typical species, while Woodward (1877, p. 26) placed *Cryptonymus* as a sub-genus of *Asaphus*, giving *A. scutalis* Salter as an example.

There has been a considerable amount of discussion over the status of the genus *Cromus*. Some authors have accepted Barrande's (1852, p. 821) definition of its characters as being of generic value, while others have referred to it as a synonym of *Encrinurus*.

Etheridge and Mitchell (1915, p. 648) failed to see how the two genera could be united. They enumerated the characters of *Cromus* as follows: "The glabella bears four pairs of distinct lateral furrows, the hypostome lacks the forward prolongation of that of *Encrinurus*; the eyes are sessile, poorly developed and, so far as known, there are but ten segments in the thorax against eleven in that of *Encrinurus*."

These two authors in describing the Encrinuridae of Australia stated that only species of *Encrinurus* were represented, thereby intimating that lateral glabella furrows are not developed on the Australian specimens of *Encrinurus*. However, Mitchell (1924, p. 51) in describing *Encrinurus frontalis* mentions the presence of pseudoglabella furrows, while in the same paper he refers to five pairs of glabella furrows, "if such they may be called", on the glabella of *Cryptonymus robustus*.

On a few well-preserved specimens of *Encrinurus borenorensis* there are developed grooves which in my opinion must be referred to as lateral glabella furrows. These are four in number, the posterior two extending right across the glabella, while the remaining anterior two are much reduced, being little better than notches in the sides of the glabella. The presence of furrows is shown to better advantage on impressions where definite ridges mark their position. The glabella lobes are four in number, the basal one being small, the others enlarged, swollen, and separated by deep glabella furrows. These are very distinct from the tubercles of the glabella and appear to have no association with them.

It is interesting to note, however, that on the inner margin of the fixed cheeks there are developed four to five enlarged tubercles which project into the dorsal furrows. These, although much smaller in size than the lateral lobes, appear to correspond to them to some extent, and the significance of these in relation to the origin of the glabella lobes must be of interest.

As a distinctive generic feature it appears as if the absence or presence of lateral glabella furrows is not a good one as far as the genera *Cromus* and *Encrinurus* are concerned. The other distinguishing features of *Cromus* are not of generic importance, and Etheridge and Mitchell, strong advocates of the separation of the two genera, admit that in general features both genera agree as far as thoracic segments, test-ornamentation, outline of the pygidium, etc., are concerned.

It is considered, therefore, that Reed, Raymond and other authors are correct in placing *Cromus* as a synonym of *Encrinurus*. Reed (1928, p. 66) came to the conclusion that even with the head-shield and pygidial characters taken into consideration it was most difficult to decide upon a natural and satisfactory classification of sub-division of the various species of *Encrinurus* sens. ext.

He recognized six sub-divisions, which were defined on morphological features and which also possess a certain phylogenetic significance. No attempt was made to introduce any new nomenclature, as Reed considered the groups did not even warrant sub-generic status and they were put forward simply as a suggested grouping.

The species described in this paper as *E. borenorensis* is not assigned readily to any one of these groups. The possession of complete and incomplete axial rings on the pygidium suggests certain groups but other diagnostic characters prevent a definite reference to any single group.

Geological Range of *Encrinurus* in Australia.

It is generally accepted that members of the genus *Encrinurus* came into existence in the Ordovician and became extinct at the close of the Silurian. The Australian species of the genus have so far been recorded only from Silurian rocks in New South Wales, Tasmania and Victoria.

In the Yass-Bowning district of New South Wales all the species of *Encrinurus*, with two exceptions, have been recorded from the Middle or Lower Trilobite Beds in the Hume Series and are below the Monograptus Horizon. The two exceptions are *E. rothwellae* Eth. and Mit. and *E. incertus* (Mit.), which occur in the Upper Trilobite Bed immediately overlying the Monograptus Horizon. These deposits are Upper Silurian in age and with them have been correlated the beds at Yarralumla and the Back Creek beds of the Tarlo River, in which the genus has also been collected.

At Quidong, near Bombala, New South Wales, a locality also referred to as Delegate, fragmentary remains of *Encrinurus* have been collected from shales associated with limestone. The limestone contains a coral fauna, including *Hercophyllum shearsbyi*, and is considered to be identical in age with the Yass beds.

The shales at Borenore, near Orange, which contain an abundance of *E. borenorensis*, as mentioned before in this paper, immediately overlie a limestone horizon with a rich assemblage of species of *Halysites*. Although this genus is well known from the Lower Devonian, it is more typically a Silurian coral. In Australia *H. chillagoensis* Eth. is recorded from Chillagoe in Queensland in a limestone originally thought to be Silurian in age. In a recent paper, Hill (1943, p. 58) thinks it possible that Lower and Middle Devonian may be represented in the Chillagoe limestone belt. However, as pointed out earlier in this paper, *Halysites pycnoblastoides* Eth., with other associated, unrecorded species of the genus, from the Bango Series at Yass, New South Wales, is definitely of Lower Silurian age. The type locality of this species is at Spring Creek, Parish Barton, in a coralline limestone which has been correlated with the *Halysites* limestone at Borenore. There seems to be little doubt that the genus *Halysites* in New South Wales, as far as our present knowledge is concerned, is restricted to the Silurian. The overlying shales at Borenore containing *Encrinurus* would also be of the same age.

In Victoria one species, *Encrinurus* (*Cromus*) *spryi*, was described by Chapman (1911, p. 297) from the Melbournian Series of the Silurian. Although Etheridge and Mitchell (1915, p. 653) stated that this specimen was possibly not an *Encrinurus* as understood by them, it had previously been examined by Mitchell and identified as *E. mitchelli*. It thus would no doubt fall into the genus *Encrinurus* sens. ext. The age of the Melbournian beds has recently been placed as the equivalent of the Lower Ludlow.

The specimens of *Encrinurus* from Tasmania have been collected from localities where the beds are supposedly of Silurian age, but so far little information is available regarding their exact geological position. In a recent paper, Gill (1948, p. 68), in recording *Encrinurus* (*Cryptonymus*) *silverdalensis* Eth. and Mit. from strata of the Eldon Group on the Lyell Highway, near Queenstown, Tasmania, raised a doubt whether *Encrinurus* is an absolute index of Silurian age. It is still largely an open question, however, whether the species of *Encrinurus* at this locality were collected from Silurian or Devonian rocks.

Notes on the Family Lichidae Corda, 1847, in Australia.

Representatives of the family Lichidae are comparatively rare in Australian rocks and in most instances only fragmentary material has been dealt with. Two specimens of incomplete cranidia and a fragment of a pygidium belonging to this family were collected from the Lower Silurian trilobite horizon at Borenore.

One of these, an incomplete cranidium, reveals some affinities with the genus *Dicranogmus* of Corda, and is described in this paper as *D. bartonensis*. The remaining material is indeterminate.

Etheridge and Mitchell (1917, p. 503) revised the then only two described species of the Lichidae from Australia, *Lichas australis* McCoy (1876, p. 18) and *Lichas palmata* var. *sinuata* Ratte (1886, p. 1065, and 1887, p. 95). Etheridge and Mitchell referred *Lichas australis* to the genus *Acanthopyge* of Corda. Gill (1939, p. 140) when adding to the description of the species made no reference to this change in nomenclature, the species being left in the genus *Lichas*.

Gürich (1901, p. 527) proposed the name *Euarges* for forms after the type of *Lichas haueri* Barrande from Bohemia. McCoy had already stressed the relationship of *Lichas australis* with *L. haueri*, although Gill, after an examination of some better material, was able to determine distinctive points of difference between the two species. Phleger (1936, p. 610) places Australia in the range of the genus *Euarges*, apparently recognizing *L. australis* as a species of that genus.

It is interesting to note that *Euarges australis* (McCoy) is now considered by Gill (1945, p. 184) to be of Lower Devonian age and not Silurian, as thought originally. He lists the localities from which *E. australis* has been collected—"junction of Woori-Yallock and Yarra (Stewart's Station)" and "Syme's Quarry, Killara"—as being of Lower Devonian (Yeringian) age.

Etheridge and Mitchell (1917, p. 504) referred *Lichas palmata* var. *sinuata* Ratte to the genus *Corydocephalus* of Corda, 1847. Only the pygidium of this species has been described, but an examination of some fragments of the glabella supports its reference to the genus *Corydocephalus* or, as it is now recognized by Phleger and Warburg, *Trochurus* of Beyrich, 1845. A small fragment of the glabella of *Trochurus palmata* var. *sinuata* Ratte shows the characteristic median depressed area immediately anterior to the occipital ring, with a single prominent tubercle situated at each side. No complete glabella lobes are preserved on this fragmentary specimen, but the furrows present are wide and deep. The occipital ring is arched.

This species was collected from a limestone near the Wellington Caves, New South Wales, originally thought to be of doubtful Upper Silurian age, but now known to be of Lower Devonian age.

Another reference to the family Lichidae in Australian rocks is that of Gürich (1901, p. 532), when he described *Craspedarges wilcanniae* from Upper Devonian rocks at White Cliffs, New South Wales.

An incomplete and badly preserved specimen from Rock Flat Creek, New South Wales, was recorded by De Koninck as having relationships with *Lichas palmata* Barrande. This specimen was destroyed in the Garden Palace fire of 1882, and although Etheridge and Mitchell (1917, p. 504) state that it may belong to *T. palmata* var. *sinuata* (Ratte), it would be far better to ignore any reference to this specimen in the future. De Koninck did not give any description or figure of the single specimen.

DESCRIPTIONS OF SPECIES.

Order OPISTHOPARIA.

Family LICHIDAE Corda.

Genus DICRANOGMUS Corda, 1847.

[Genotype, *Dicranogmus simplex* (Barande, 1846).]

Dicranogmus bartonensis, sp. nov.

(Plate xvi, figure 8.)

Holotype, F.42932, Australian Museum collection.

Specific Characters.—Glabella wider than long, rather narrowly rounded and convex in front, flattened posteriorly; curving steeply downwards anteriorly. Median lobe about 8 mm. in length, slightly more than twice as long as wide; projecting beyond bicomposite lobes. Lateral margins almost parallel, with a slight widening anteriorly; antero-lateral extremities pointed. Median lobe strongly curved downwards in front from the inner extremities of the bicomposite lobes; from this point the lateral margins are parallel with the median lobe curving gradually posteriorly. Convexity from side to side fairly strong and uniform. Bicomposite lobes elongated, somewhat wedge-shaped, tapering posteriorly, following the same general curve of the median lobe. Prolonged first lateral furrows strongly defined posteriorly, but becoming almost obsolete at the inner extremities of the bicomposite lobes; anteriorly the furrows are weak and ill defined, but there is no complete fusion between the bicomposite lobes and the antero-lateral portions of the median lobe. The second lateral furrows are well developed, deep, curving broadly around the bicomposite lobes, bending downwards from their junction with the first lateral furrows and extending to the occipital furrow. That portion of the glabella consisting of the median lobe and the bicomposite lobes well marked off by the second lateral furrows is very convex and elevated well above the remainder of the glabella.

Third lateral lobes large, inner portion slightly convex, flattening and rapidly widening outwardly, confluent with fixed cheeks. Occipital lobes sub-ovate, well defined; situated beyond main portion of occipital ring, marked off by well-impressed, short furrows curving around the occipital lobes and joining the marginal furrow. Occipital ring broad, straight below the median lobe, then curving downwards and outwards. Surface is relatively coarsely tuberculate with tubercles of varying size and height.

Remarks.—A single incomplete cranidium is the only representative of the above species which has, with some hesitation, been placed in the genus *Dicranogmus*. It differs from typical members of that genus in having the prolonged anterior lateral glabella furrows weakly marked in front, whereas in the genotype, *D. simplex*, they are obsolete, the bicomposite lobes being fused anteriorly with the antero-lateral portions of the median lobe. Warburg (1939, p. 147), however, has placed *Lichas aequalis* Tornquist in the genus *Dicranogmus*, and in that species the prolonged first anterior glabella furrows are weakly developed and not obsolete as in the genotype. Warburg considers that the character of the anterior portions of these furrows, whether they are weak or obsolete, does not seem to be of generic importance. Another point of difference is that the prolonged anterior furrows in *D. bartonensis* do not extend back directly to the occipital furrow. They meet the second glabella furrows back from the inner extremities of the third lateral lobes and communicate with the occipital furrow by well-defined and slightly curved furrows.

The Australian species has some characters in common with *Trochurus speciosus* Beyrich, 1845, the genotype of that genus. It differs, however, in the third lateral lobes being separated from the median lobe by a distinct furrow and also in that the third lateral lobes are confluent with the fixed cheeks.

Locality.—Portion 292, Parish Barton, County Ashburnham, near Borenore, New South Wales.

Geological Age.—Lower Silurian.

Order PROPARIA.

Family ENCRINURIDAE.

Genus ENCRINURUS Emmrich, 1844.

Encrinurus borenorensis, sp. nov.

(Plate xv, figures 1–7; Plate xvi, figures 1, 5–6.)

Holotype, F.42694. Paratypes, F.42909, F.42696, F.43053, Australian Museum collection.

Specific Characters.—Cranidium sub-triangular in outline. Glabella prominent, broadly sub-pyriform, as long as wide; rounded anteriorly and narrowing gradually to half its greatest width at the occipital furrow. Moderately convex, sharply curved downwards in front, then sloping gradually posteriorly. Ornamented with numerous but not closely packed, well-developed tubercles following no definite pattern except on the extreme posterior constricted area. Immediately above the occipital furrow two tubercles are situated centrally, one on each side of a median line. The next row consists of three tubercles. On each side of the lower half of the glabella are developed five lateral glabella lobes, projecting to a marked degree into the axial furrows. The most posterior or basal lateral glabella lobes are small; the fourth, third and second lobes are large, while the most anterior or first are slightly smaller in size. Lateral furrows well developed, deep, but not extending far across the glabella. The three posterior lateral glabella furrows are wide and fairly elongate, the most anterior pair short.

The axial furrows are deeply impressed, wide, and impinged upon posteriorly by the lateral glabella lobes and by four enlarged tubercles on the inner margin of the fixed cheeks. The lobes and tubercles alternate with one another.

Occipital furrow well defined, narrow and deeply impressed at its junction with the axial furrows. Occipital ring wide and flattened, ornamented with a single row of tubercles, slightly arched, extending on both sides to a point immediately below the inner margin of the fixed cheeks and separated from the posterior lateral borders by a short, but very distinct, outwardly sloping groove.

Fixed cheeks moderately convex, widely elongate, narrowing and curving downwards to the genal angles. On the margin of the axial furrow four enlarged tubercles are developed which project into the groove. Surface covered with tubercles smaller in size than those on the glabella. The well-defined, wide and deep posterior marginal furrows of the fixed cheeks extend from the lateral extremities of the occipital furrow to the genal angles. The posterior borders rounded, not as wide as the marginal furrow, ornamented with a single row of tubercles, increasing in width at the genal angles. The borders curve downwards rather considerably to the genal angles, which are somewhat produced by a thickening of the borders but are not developed into genal spines.

Free cheeks, relatively large, wide and very convex, ornamented with uniform tubercles of similar size to those of the glabella. The latero-posterior portions possess wide, rounded borders, increasing considerably in width both at the genal angles and at the junctions with the axial furrows; they terminate slightly forward of these furrows. Borders ornamented with a row of closely set tubercles. Marginal furrows deep, particularly where they communicate with the axial furrows, posteriorly communicating with the transverse marginal furrows of the fixed cheeks. The inner surface of the posterior portion of the free cheeks rises abruptly from the marginal furrow, almost straight-sided, then moderately convex; the pedunculate eyes are placed on the inner margin of the free cheeks in a slightly depressed area free of tubercles. The anterior portions of the free cheeks inside the axial grooves, and which rest on the glabella front, very convex, widely elongate. The border originates from that of the posterior portion, but is considerably depressed, narrow, and gradually decreasing in width anteriorly. Ornamented with a single row of small tubercles. Axial furrows, where they cross the free cheeks, deep and very pronounced, shallowing as they pass around and forward. Facial sutures are of the usual generic type.

Dimensions of the cephalon are as follows:

	F.42694.	F.42696.
Length of cephalon	23 mm.	24 mm.
Width of cephalon	46 mm.	—
Length of glabella, excluding occipital ring	21 mm.	21 mm.
Width of glabella	21 mm.	21 mm.

Thorax unknown.

Pygidium.—Large, sub-triangular, much wider than long, not produced into a caudal spine. The axial furrows broad and well defined anteriorly, narrowing posteriorly. Axis prominent, the width at the anterior end being about one-fourth the total width of the pygidium; posteriorly tapering to a relatively fine point at the extremity. Axial rings are twenty-two in number and consist of both continuous and discontinuous types. From above downwards the axial rings are characteristically as follows: The first five are continuous, ornamented with closely set tubercles, and distinctly arched; the remainder are straight, the sixth and seventh discontinuous with a centrally placed tubercle in each smooth median space. The eighth and ninth are discontinuous, with no apparent central tubercle; tenth and eleventh are more or less continuous, with a central tubercle, while the twelfth, thirteenth and fourteenth are discontinuous, with smooth central spaces. The fifteenth is continuous, the sixteenth discontinuous, with a central tubercle, the seventeenth discontinuous and the remainder continuous.

Pleural lobes anteriorly curve gradually downwards from the axial furrows to the lateral margins, abruptly so at the posterior end; lobes marked by ten pleural ribs, which are stronger anteriorly. Pleural ribs bent backwards, progressively becoming more pronounced posteriorly, where the last pair are almost parallel with the axis. Surface of ribs ornamented with small tubercles.

The dimensions of two pygidia are as follows:

	F.42926.	F.43053.
Greatest width	50 mm.	31 mm.
Length	32 mm.	22 mm.
Greatest width of axis	13 mm.	9 mm.

Observations.—Complete specimens of this species would attain a length of approximately 90 mm. and a width of 55 mm., and to my knowledge it is the largest of any known species of the genus *Encrinurus*. The specimens dealt with in this paper are all incomplete and non-testiferous cranidia and pygidia. No segments of the thorax have yet been found.

The extremely large size of *Encrinurus borenorensis*, the almost oval-shaped glabella with a wide posterior constricted portion and very distinctive lateral glabella lobes are characteristic features of this species. Other important differences are the extreme downward curvature of the posterior borders of the fixed cheeks, the relatively small eyes, and also the proportionately greater width of the pygidium.

The species can be compared to some extent with *E. robustus*, *E. bowningensis* and *E. etheridgei*. The latter species attains a length of two and a half inches and it has well-developed lateral glabella lobes. It differs markedly, however, from *E. borenorensis* in the shape of the pygidium and certain features of the cephalon, particularly the structure of the posterior borders of the fixed cheeks and the type of the tuberculation on the glabella, fixed cheeks and the free cheeks. From *E. robustus* and *E. bowningensis* it differs in a number of important features and comparison with either of them is not necessary.

Following is a table showing the number of pleural ribs and axial rings found on the pygidia of *E. borenorensis* and some allied Australian species, although doubt has been raised by some authors whether these are good diagnostic characters:

	Pleural Ribs.	Axial Rings.
E. borenorensis, sp. nov.	9	22
E. etheridgei Mitchell	13	36
E. bowningensis Foerste	7	20
E. silverdalensis Eth. & Mit.	10	26–30
E. robustus Mitchell	11–12	24
E. mitchelli Foerste	10–11	26–32

Locality.—Portion 292, Parish Barton, County Ashburnham, Borenore, near Orange, New South Wales.

Geological Age.—Lower Silurian.

Superfamily PHACOPIDACEA.
Family PHACOPIDAE Hawle and Corda.
Subfamily PHACOPINAE Reed.
Genus PHACOPS Emmrich, 1839.
Phacops crosslei Eth. & Mit.

1895. *Phacops crosslei* Etheridge and Mitchell, Proc. Linn. Soc. N.S.W., x, (2), 3, p. 489, pl. xxxix, figs. 9–11.

1915. *Phacops crosslei* Chapman, Proc. Roy. Soc. Vict., xxviii (N.S.), p. 168, pl. xv, figs. 14–15.

Observations.—In the collection of trilobites from Borenore there are several poorly preserved and exfoliated cranidia, but more or less complete, which have been identified as the above species.

It is difficult to find any important points of difference between *P. crosslei* and *P. serratus*, a fact already stressed by Etheridge and Mitchell (1895, p. 497). These authors state that the latter species is not separable from the former except by the presence of dorsal spines, a feature which in their opinion could be sexual. The glabella of *P. serratus*, in their opinion, seems to be more tumid in front and is more sharply contracted behind by the intercalary groove than in *P. crosslei*.

The cranidia representative of the above species compare favourably with the type material on which the species was based. They appear to be somewhat stronger and larger than the specimens described as *P. serratus*, and also the glabella does not possess the tumidity of that species. In each case the constricted portion of the glabella is wider at its junction with the occipital ring than is found in *P. serratus* and there is no trace of a spine on the occipital ring.

Chapman (1915, p. 168) recorded *P. crosslei* from several localities in Victoria and from deposits which at that time were thought to be of Silurian age (probably

Yeringian). In two recent papers Gill (1940 and 1945) refers the rocks of Yeringian age to the Lower Devonian, including those at the localities from which *P. crosslei* had been collected. A re-examination of the material identified by Chapman may prove the specimens to possess points of difference from the typical *P. crosslei*, which in New South Wales is fairly abundant in beds of definite Silurian age in the Yass district. Chapman does mention that the vertical rows of lenses in the eyes of the Victorian specimens vary from those of the type specimens.

Locality.—Portion 292, Parish Barton, County Ashburnham, Borenore, near Orange, New South Wales.

Geological Age.—Lower Silurian.

Phacops macdonaldi, sp. nov.

(Plate xvi, figures 2–4, 7, 9.)

Holotype: F.42952. Paratypes: F.42954, F.42949, F.43060, F.42946, Australian Museum collection.

Specific Characters.—Complete body unknown. Cephalon semi-ellipsoidal in outline, more than twice as wide as long. Margin broadly and evenly curved in front and laterally; genal angles rounded, not declining below the straight posterior borders of the free cheeks. Subcranial furrow well developed, continuous, slightly wider in the median position. The hinder border of the furrow the higher, rounded, narrowing on the lateral cheek extensions and becoming almost knife-edged. Glabella in front occupies about one-half of the width of the cephalon; it is somewhat pelecoidal in shape, only slightly curved along the anterior margin, with pointed angles at the junctions of the concave to straight lateral margins; relatively wide at the constricted posterior portion adjacent to the neck-ring. The glabella does not protrude beyond the hinder anterior border, and it is half again as wide as its length including the neck ring; strongly convex from side to side, with a short and abrupt downward slope in front and posteriorly sloping gradually to the intercalary furrow. Dorsal furrows deeply impressed posteriorly, but shallowing and widening in front of the palpebral lobes, bending outwards to meet the extremities of the glabella at an acute angle.

The basal or intercalary glabella furrow, well impressed and extending across the width of the glabella, the sides directed forwards and meeting in the mid-line. The second pair of glabella furrows are short, ill-defined and straight, and almost in communication with the apex of the intercalary furrow. Traces of a frontal pair are discernible but are almost obsolete. The constricted portion of the glabella between the intercalary furrow and the occipital furrow is prominent, elevated and rounded.

Occipital ring robust, elevated, very convex, wider than basal lobes. Occipital furrow well defined, narrow and not deeply impressed, terminating in cavities in which two small but well-developed basal lobes are developed; these are saparated in front by the intercalary furrows, laterally by the dorsal furrows and small furrows extending from the intercalary furrow and communicating with the occipital furrow.

Cheeks wide, flattened, with palpebral lobes and eyes abruptly elevated; facial sutures indistinguishable. Posterior marginal furrow is deeply impressed, narrow, becoming almost obsolete near the genal angles. Posterior border well defined, increasing in width at the rounded genal angles.

Palpebral lobes swollen, elevated almost to the level of the glabella in some specimens, but generally lower. Eyes parallel to axis, curved from side to side, semi-lunar or crescent-shaped; anterior extremities touching dorsal furrows and situated well inside the frontal extremities of the glabella; posterior extremities opposite intercalary furrows, separated from the dorsal furrows by a swollen area of the fixed cheeks, and below almost touching the marginal furrows. Distinct shallow furrows originate from the dorsal furrows immediately below the anterior extremity of the eyes and pass posteriorly around and under them, widening to form depressed areas between the borders and the raised palpebral lobes. The lentiferous surface of the eyes with about 74 lenses arranged in 17 rows. The first row has two lenses, the second three, the third four, and then follow eleven rows of five, the remaining three rows containing four, three and two respectively. Only the casts of the cups which support the lenses are preserved, and these are separated from one another by narrow flattened areas.

The thorax is unknown.

Pygidium wide, more than semi-circular, moderately convex and almost twice as wide as long. Axis prominent, convex about one-third the width of the pygidium at the anterior end, tapering posteriorly to a bluntly rounded end at one-third of its length from the margin. Axis contains six or seven annulations separated from the pleural lobes by broad, shallow, dorsal furrows. Pleural lobes convex, not nearly as elevated as the axis, with five pairs of pleural ribs, which do not cross a rather broad convex margin.

The compiled dimensions of six specimens are as follows:

	F.42952.	F.42949.	F.42947.
Width of cephalon	28 mm.	28 mm.	28 mm.
Length of glabella	13 mm.	12 mm.	13 mm.
Width of glabella	15 mm.	13 mm.	13 mm.

	F.43060.	F.42957.
Length of pygidium	12 mm.	13 mm.
Width of pygidium	23 mm.	22 mm.
Width of axis of pygidium	6 mm.	6 mm.
Length of axis of pygidium	9 mm.	9 mm.

Observations.—This outstanding species is based on a series of incomplete head-shields and several pygidia, but sufficient characters are present to reveal important points of difference from other Australian species of the genus. There is no trace of any tuberculation on the specimens, a feature common to the genus *Phacops*, but this can be explained by the strongly exfoliated nature of the material.

Etheridge and Mitchell (1895, p. 486) described four new species of *Phacops*: *P. crosslei* and *P. latigenalis* from the Silurian of New South Wales, and *P. sweeti* and *P. mansfieldensis* from the Yeringian Series of Victoria. They also gave a further description of *P. serratus* of Foerste and mentioned that they were of the opinion that *P. fecundus* McCoy (*non* Barrande) is in all probability identical with *P. sweeti.*

These are the only species of *Phacops* recorded previously from Australian rocks. As mentioned earlier in this paper, Chapman (1915, pp. 168–9) recorded the occurrence of *P. crosslei* and *P. serratus* from rocks of Yeringian age in Victoria, now considered by Gill to be of Lower Devonian age and not Silurian. In a recent paper Gill (1948, p. 14) states that *P. fecundus* recorded by McCoy from Victoria differs from the typical Bohemian species.

Of all the above species the wide cephalon of *P. macdonaldi*, a little more than twice as wide as long, and the wide flattened lateral margins of the cheeks compares rather favourably with *P. sweeti.* In that species, however, the eyes are very large, with 280 lenses in twenty-two vertical rows. The shape of the glabella of *P. macdonaldi* is a characteristic feature in that the frontal border is only slightly curved, almost straight, with rather pointed extremities where it is met by the outwardly curving dorsal furrows. The eyes are placed close to the posterior border of the cheeks and are separated from the frontal border by a comparatively wide flattened area; at least one-half of the eyes is placed inside a perpendicular line if dropped from the frontal glabella extremities. The pygidium of *P. macdonaldi* differs to some extent from those of other Australian species in being broad and possessing a very elevated and wide axis.

Dun (1907, p. 265) figured a small pygidium as *Phacops* (?) from Oakey Creek, Parish Barton, County Ashburnham. This specimen is entirely different from that of *P. macdonaldi* in that the axis is narrower and there is a greater number of pleural ribs.

***Locality*.—Portion 292, Parish Barton, County Ashburnham, Borenore, near Orange, New South Wales.**

***Geological Age*.—Lower Silurian.**

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EXPLANATION OF PLATES.

Plate xv.

***Encrinurus borenorensis*, sp. nov.**

Fig. 1.—A complete glabella showing tuberculation and enlarged lateral glabella lobes. The right fixed cheek is attached and exhibits the downward curve to the genal angle. (Holotype, A.M. Coll., F.42694.)

Fig. 2.—Another glabella with incomplete right and left fixed cheeks. (A.M. Coll., F.42696.)

Fig. 3.—An enlarged right free cheek showing the deep marginal furrow and wide border. The eye is situated in a slightly depressed area free of tubercles. (A.M. Coll., F.42923.)

Fig. 4.—A poorly preserved glabella but with complete right and left fixed cheeks. (A.M. Coll., F.42909.)

Fig. 5.—Another view of specimen in figure 2. The tubercles are shown to better advantage.

Fig. 6.—A pygidium showing complete and incomplete axial rings. (A.M. Coll., F.43053.)

Fig. 7.—A larger pygidium. (A.M. Coll., F.42926.)

Plate xvi.

***Encrinurus borenorensis*, sp. nov.**

Fig. 1.—The same specimen figured on Plate xv, figure 1. (Nat. size.)

***Phacops macdonaldi*, sp. nov.**

Fig. 2.—Sub-cephalic view showing the sub-cranial furrow. The lateral cheek extensions are missing. (A.M. Coll., F.42954.)

Fig. 3.—An incomplete specimen showing portion of the glabella and the position of the palpebral lobe and eye. (A.M. Coll., F.42946.)

Fig. 4.—An incomplete cranidium showing the broadly curved margin in front and the well-developed flattened cheeks. (F.42952.)

Encrinurus borenorensis, sp. nov.

Fig. 5.—A left free cheek showing the wide border and deep furrow which in front of the axial groove becomes narrow and depressed. (A.M. Coll., F.42693.)

Fig. 6.—The latero-posterior portion of a right free cheek. (A.M. Coll., F.42886.)

Phacops macdonaldi, sp. nov.

Fig. 7.—An incomplete cranidium. (A.M. Coll., F.42949.)

Dicranogmus bartonensis, sp. nov.

Fig. 8.—The holotype exhibiting the median lobe, a bicomposite lobe and a third lateral lobe of an incomplete glabella. (A.M. Coll., F.42932.)

Phacops macdonaldi, sp. nov.

Fig. 9.—An almost perfect pygidium featuring the pygidial characters of the species. (A.M. Coll., F.43060.)

Howard Hughes, photo.

STUDIES IN ICHTHYOLOGY.

No. 14.*

By Gilbert P. Whitley, F.R.Z.S.
Curator of Fishes, The Australian Museum, Sydney.

(Plate xvii and Figures 1–5.)

Family CARCHARIIDAE.

Genus **Odontaspis** Agassiz, 1835.

Odontaspis Agassiz, Poissons Fossiles, iii, 1835, p. 55; and 1838, p. 87; 1843, p. 287, pl. G, figs. 1, 1*a–d* (as *Lamna*) and pl. P, figs. 1–4. Orthotype, *Carcharias ferox* (Risso). *Odontaspis* White, Vertebr. Faunas Engl. Eocene, May, 1931, p. 48.

Odontaspis herbsti, sp. nov.

(Plate xvii, fig. 1, and Figure 1.)

Head subconic with the long snout broadly rounded from both dorsal and lateral aspects, not produced as in *Mitsukurina*. Nostrils large, transverse, with small, rather acute lobe, much nearer mouth than tip of snout. Eyes large, oval, nearer end of snout than first gill-opening, not adnate to side of head, and without nictitating membrane; pupil a vertical ellipse. No visible spiracle. Aquaeductus vestibuli inconspicuous, 10·7 inches from tip of snout. Mouth crescentic, anteriorly level with nostrils and before eye-level and not reaching far behind eyes. Tongue and palate rather rough. Teeth said to be embedded in the gums in the live shark, except when biting, when they are exserted and the lips are drawn back. No central symphyseal tooth, the shagreen entering the mouth at symphyses. Teeth mostly with a pointed central fang and two (rarely three) small acute cusps on each side of it, but there is much variation in size and shape on different parts of the jaws, and those at the corners of the mouth are very small. There are no serrations. The enlarged anterior fangs are flexuous and thick, but the lateral ones are thinner and more erect. The two subequal roots are separated by an arc and the bases of adjacent teeth do not overlap. The teeth of the lower jaw are slenderer than those of the upper. Some of the anterior teeth of the holotype were broken during its struggles; it has four small "eye-teeth" on each side in upper jaw.

The dentition is better shown in the cleaned jaws of the paratype, a larger specimen (Austr. Mus. regd. no. IB. 1859), which agrees well with Dr. Errol White's restricted concept of the genus *Odontaspis* (White, Vertebr. Faunas Engl. Eocene, 1931, page 47), that is, "the crowns of the teeth, especially in the front of the jaws, are very sharply pointed and flanked (on either side) by two lateral denticles equally sharp". There is

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* For No. 13, see Records of The Australian Museum, Vol. xxii, Part 1, June 30, 1948, pp. 70-94, figs. 1-11.

Thanks are due to the Council of the Royal Zoological Society of New South Wales for all illustrations (except Plate xvii, figure 1) from the author's forthcoming "Fishes of Australia".

no central symphyseal tooth, as in some sharks, there being a gap with a small tooth (called by Dr. White the symphyseal) on each side of it in the middle of the jaw. As in Agassiz's and White's accounts, in my paratype "the first tooth (the Symphyseal) in both upper and lower jaws is much smaller than the second (1st Anterior) which is the largest of all [though in my paratype the 1st and 2nd Anterior are subequal in the upper jaw and smaller than those in the lower jaw]; thence in the lower jaw the teeth decrease gradually in size towards the back of the mouth, but in the upper jaw this gradual diminution is interrupted by the fourth, fifth, sixth and seventh (the 'eye') teeth, which are even smaller than the first" [only slightly so in mine, in which, moreover, the fifth teeth of the right side of the upper jaw have not been developed].

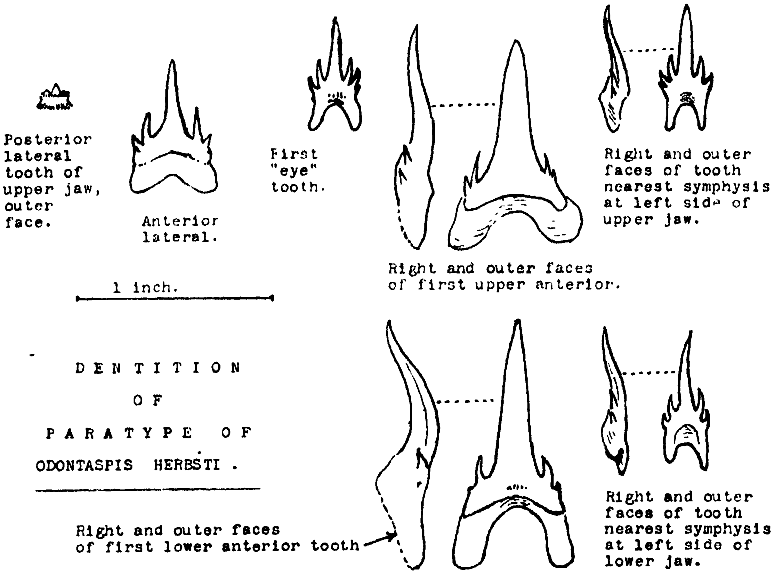

Posterior lateral tooth of upper jaw, outer face.
Anterior lateral.
First "eye" tooth.
Right and outer faces of tooth nearest symphysis at left side of upper jaw.
Right and outer faces of first upper anterior.
1 inch.
DENTITION OF PARATYPE OF ODONTASPIS HERBSTI .
Right and outer faces of first lower anterior tooth
Right and outer faces of tooth nearest symphysis at left side of lower jaw.

Figure 1.—*Odontaspis herbsti* Whitley. Dentition of paratype from 200 miles south of Sydney, New South Wales.

G. P. Whitley del.

The teeth are in eight rows from front to back. Dental formula $\frac{48}{40}$. The inner of the two lateral cusps in the Australian species is longer and more acute than in Agassiz's figures and there are fewer posterior teeth decreasing in size backwards. Labial grooves slit-like. Interorbital slightly convex. Cheeks swollen over the large jaws. Anterior part of back and shoulders rather swollen. Ampullae of Lorenzini conspicuous on each side above and below snout. Five lateral gill-slits, the first four subequal, the last shorter, just before pectoral base; they do not cut the ventral surface as in *Lamna*, and the fourth and fifth are closest together.

Body elongate, cylindrical and rounded; the paunch rotund "like a cow's belly". Girth at origin of first dorsal about 27 inches. Depth a little before ventral origins, nine inches. The greatest is at the forequarters. The depth lessens greatly after the ventral fins. Caudal peduncle O-shaped in transverse section, without keels. Lateral line conspicuous, running from above last gill-slit along upper part of side to middle of caudal peduncle and then along upper lobe of tail. Shagreen fine, rather rough to the touch. Dermal denticles small, close-set, imbricate, each with three well-marked complete carinae, the middle one longest, the others diverging, set on a raised base.

Biometrics, following scheme propounded in Proc. Linn. Soc. N.S. Wales, lxviii, 1943, p. 114:

H. 1	12 in.	B 8	1·4 in.
2	15¾	9	1·65
3	5	F. 1	7·5
4	4⅛	2	7
5	15¾	3	1·8
6	35½	4	11·4
7	$1^{5}/_{16}$	5	4¾
8	0·9	6	4
9	3·8	7	1¾
10	(no spiracle)	8	5¼
11	1 in.	9	4⅛
12	2½	10	3
13	4½	11	1·35
14	$4^{1}/_{16}$	12	2·5
15	½	13	—
16	½	14	8·5
17	3⅛	15	3·5
18	3·2	16	19·5
B. 1	48½	17	5·3
2	40	18	5·6
3	21½	19	1¼
4	12	20	10
5	*c.* 5	21	17½
6	2½	22	6½
7	2		

Other measurements (in inches): Nostril to tip of snout, 4·13; nostril to eye, 1·4; nostril to corner of mouth, nearly 4; distance between outer angles of nostrils, 3·8; ramal length of mouth, 3·8; eye to first gill-opening, 6½; eye to last gill-opening, *c.* 10; distance between pectorals anteriorly 7, and posteriorly 5½; distance between ventral origins, 3·7.

Vent large. No interdorsal ridge. No umbilical scar. Preanal length longer than post-anal.

Fins similar to those of *Carcharias*, rather rounded, without spines. First dorsal origin much nearer pectorals than ventrals, its vertical height less than its length. Second dorsal well developed, smaller than first. Anal similar to but entirely behind level of second dorsal. Pectorals short and rounded, upper and lower margins convex and posterior margin almost straight, their inner angles barely reaching level of first dorsal origin, their tips extending back to below anterior half of first dorsal base. Ventral origin nearer origin of second dorsal than base of first dorsal. Claspers small in this specimen, not reaching to ventral tip. Anterior edges of all fins trenchant. Caudal axis little raised. No caudal pits but a pronounced bump at upper caudal origin; dorsal ridge of caudal fairly straight, subcaudal followed by notch, lower caudal lobe rounded.

Flesh whitish. Liver weight, 11 pounds. Stomach contents unidentifiable, apparently digested fish vertebrae and remains, also one pillbug (?). Spiral valve with 25 rings. Vertebral centra radially asterospondylic, with radiating calcifications, without Maltese cross-like secondary calcification.

General colour when fresh almost uniform light grey, on head, body, fins and claspers, slightly paler ventrally and fins with smoky-grey margins, but without dark spots or tips. Lower caudal lobe dusky. Most fins with white posterior axils. Eye bluish-grey with some green below.

Described and figured from the holotype of the species, a young male, 5ft. 6 in. long and weighing 55 pounds. Austr. Mus. regd. no. IB. 2136.

Loc.—Three miles north of Gabo Island, New South Wales; 75 fathoms, steam trawler "Olive Cam" (Capt. W. Smith), night of 14th May, 1948.

Presented by Mr. W. A. Herbst, of Sydney. It was very savage when netted and snapped at everything within reach.

Also paratype jaws from 200 miles south of Sydney, N.S. Wales; about 70 fathoms; trawler "Mary Cam", April, 1947; Mr. W. A. Herbst. Austr. Mus. regd. no. IB. 1859. Vernacular name: Herbst's Shark.

Range.—Southern New South Wales, trawled in 70 to 75 fathoms in April and May.

Differs from the Mediterranean genotype, *Squalus ferox* Risso (Ichth. Nice, 1810, p. 38) in dental formula and colour and in having small pectorals. Risso described the colour as "Corpore obscuré rubro, nigro maculato" or "Un rouge obscur, parsemé de grandes taches noires irrégulières, le colore en dessus et sur les côtés; le ventre est d'un gris rougeâtre". Agassiz's figure shows 27 teeth over 23 on one side of the jaws, which gives a dental formula of $\frac{54}{46}$, whereas the Australian species has $\frac{48}{40}$. Moreover, the inner of the two lateral cusps is longer and sharper in my new species than in Agassiz's figures or those of Tortonese (Atti Mus. Civ. Milano, lxxvii, 4, 1938, p. 288, fig. 1). Giltay (Mem. Mus. Roy. Hist. Nat. Belg., v, 3, 1933, p. 8) records a variation of $\frac{46 \text{ to } 54}{36 \text{ to } 48}$ in the dental formula of the Mediterranean *ferox*. Desbrosses' paper (Bull. Soc. Zool. France, lv, 1930, pp. 232–235, 5 figs.) is not available at time of writing.

Family OPHICHTHYIDAE.

Genus **Pisodonophis** Kaup, 1856.

Pisodonophis cancrivorus (Richardson).

(Figure 2.)

Ophisurus cancrivorus Richardson, Zool. Voy. "Erebus" and "Terror", Fish., 1848, p. 97, pl. 1, figs. 6–9. Port Essington, Northern Territory.

Myrophis chrysogaster Macleay, Proc. Linn. Soc. N.S. Wales, vi, 1881, p. 271. Port Darwin, Northern Territory.

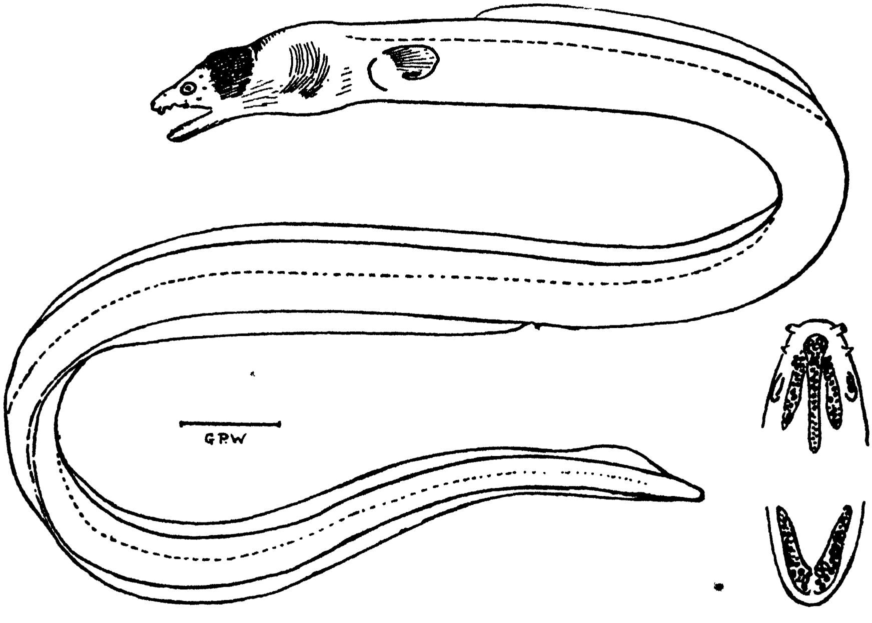


Figure 2.—*Pisodonophis cancrivorus* (Richardson). Holotype of *Myrophis chrysogaster* Macleay from Darwin, Northern Territory.

G. P. Whitley del.

Through the courtesy of the Curator of the Macleay Museum, University of Sydney (Mr. J. Henry), I have had the privilege of borrowing Macleay's type of *Myrophis chrysogaster*, now figured for the first time. Under the microscope I find that the tip of the tail is free of fins and the dorsal origin is behind the tips of the pectorals, and thus farther forward than Macleay thought. The specimen is slightly shrunken, so that the dorsal and anal fins are somewhat restored in the figure. There is a dark saddle-shaped chestnut patch over the head, otherwise no spots or bands. Ogilby, on an MS label in the type's bottle, placed Macleay's species in the genus *Pisodonophis*, a more accurate location than *Myrophis*, and Macleay's *chrysogaster* is evidently a synonym of *P. cancrivorus*. The lateral line was not shown in Richardson's figure, but is present in several north Australian specimens; the teeth may be conic or granular and molar-like, possibly through wear, and the dorsal fin may arise over or behind the pectorals.

Family SYNGNATHIDAE.

Yozia compitalis, sp. nov.

D. 21 to 23; A. 3; P. 17; C. 5. Rings 23 + about 54, but almost indistinguishable posteriorly. Subdorsal rings 2½ + 3.

Snout (10 mm.) more than half head (18), with low keel but no serrations above. Head 10·7 in total length (192), longer than dorsal base (10·5) and 2·5 in trunk (46). Interorbital (2) less than eye (2·5). No filament over eye. Operculum with radiating striae but without keel.

Superior ridges of trunk and tail discontinuous. Inferior ridges of trunk ending near vent and discontinuous with inferior ridges of tail. Median ridge of body descending over anal to join inferior tail-ridge. A ventral carina. Thus corresponds with no. 5 of Duncker's system. General characters as described for *Yozia bicoarctata brevicauda* Castelnau (in Austr. Zool., xi, 1948, p. 269, fig. 6), but differing in formulae and proportions. Trunk swollen ventrally. Body 7-angled. Vent normal. A small caudal fin present.

Life-colours chocolate-brown nearly all over, lighter below belly, and with few yellow streaks or spots on body anteriorly. Colours change on the head with the pulsating of the gill-chambers. Eye coppery with about 10 or 12 dark brown spots on iris. Fins whitish.

Described from the unique holotype, about 192 mm. or 7½ inches long; Austr. Mus. regd. no. IB. 1665.

Loc.—Pyrmont, Sydney, N.S. Wales, 9th May, 1945.

Differs from other species of *Yozia* in its formulae, proportions, and colourings.

Histiogamphelus briggsii orae, subsp. nov.

D. 25; P. 12; C. 9. Rings 21 + 35. Subdorsal rings 6 + 2.

Head (11 mm.) 3·8 in preanal length (42). Snout (5) 2·2 in head. Eye (3) 1·7 in snout. Tail (55) longer than head and body (42). Caudal fin (4) nearly 3 in head.

General characters as in McCulloch's description of *H. briggsii* (Austr. Zool., i, 1914, p. 30 and fig.) but differing in having a short keel anteriorly on operculum, eye less than two in snout, as well as in other proportions.

Colour, brownish or tan, without blue spots. A smudged, small, dark brown spot on most rings at the ridges. Lips and nostrils yellow. Dorsal base purplish-brown; pectoral base brown, the fins themselves plain whitish. Caudal dark brown tipped with cream.

Described from the unique holotype of the subspecies, a specimen 97 mm. in total length or about 3¾ inches. Austr. Mus. regd. no. IB. 84.

Loc.—Thompson's Bay, Coogee, near Sydney, New South Wales; Mr. A. K. Carter, 1939.

Family MELANOTAENIIDAE.

Quiris, gen. nov.

Orthotype, *Quiris stramineus*, sp. nov.

A genus of freshwater atherines from the Northern Territory of Australia similar to *Telmatherina* Boulenger, 1897, and *Paratherina* Aurich, 1935, from Celebes and *Charisella* Fowler, 1940, from New Guinea, but easily distinguished by the remarkable labial dentition exterior to the jaws, as described below.

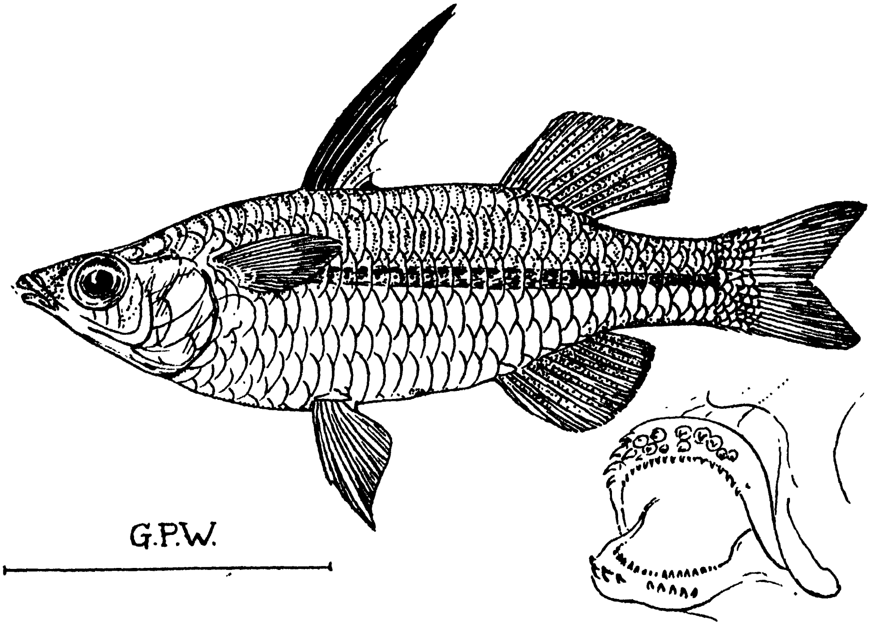
Other diagnostic characters are the few short gill-rakers, the somewhat anterior insertion of the anal fin, the robust form, the presence of a silvery lateral band, a single row of cheek-scales, the filamentous dorsal spines and the 33 vertebrae.

Quiris stramineus, sp. nov.

(Figure 3.)

D. vii/i, 9; A. i, 11; P. 14; V, i, 5; C. 15 branched rays. About 28 scales along body. Tr. 6. Pred. 10.

Head (15·5 mm.) 3·4, depth (18) 3 in standard length (54). Eye equals snout (5), less than interorbital (6) and postorbital (5·5). Longest dorsal spines 19 mm.; width at pectoral base, 9; pectoral, 10; predorsal length, 24; depth of caudal peduncle, 7; its length, 8.



. Figure 3.—*Quiris stramineus* Whitley. Holotype from Katherine River, Northern Territory. G. P. Whitley del.

Snout jutting slightly over preorbital. Premaxillary protractile, pedicles about half eye. Maxillary bluntly hook-shaped, slipping under preorbital. Upper lip overhanging lower. Mouth-opening small, oblique, bordered by premaxillaries and mandibles, broadly arched, descending steeply at sides, not markedly notched. Mandibular rami gently rising. Mouth not quite reaching below eye.

Short strong hook-like teeth in upper and lower lips exterior to jaws in 1 to 3 rows. A single series of pointed, slightly movable teeth around front of each jaw. Vomer

Through the courtesy of the Curator of the Macleay Museum, University of Sydney (Mr. J. Henry), I have had the privilege of borrowing Macleay's type of *Myrophis chrysogaster*, now figured for the first time. Under the microscope I find that the tip of the tail is free of fins and the dorsal origin is behind the tips of the pectorals, and thus farther forward than Macleay thought. The specimen is slightly shrunken, so that the dorsal and anal fins are somewhat restored in the figure. There is a dark saddle-shaped chestnut patch over the head, otherwise no spots or bands. Ogilby, on an MS label in the type's bottle, placed Macleay's species in the genus *Pisodonophis*, a more accurate location than *Myrophis*, and Macleay's *chrysogaster* is evidently a synonym of *P. cancrivorus*. The lateral line was not shown in Richardson's figure, but is present in several north Australian specimens; the teeth may be conic or granular and molar-like, possibly through wear, and the dorsal fin may arise over or behind the pectorals.

Family SYNGNATHIDAE.

Yozia compitalis, sp. nov.

D. 21 to 23; A. 3; P. 17; C. 5. Rings 23 + about 54, but almost indistinguishable posteriorly. Subdorsal rings 2½ + 3.

Snout (10 mm.) more than half head (18), with low keel but no serrations above. Head 10·7 in total length (192), longer than dorsal base (10·5) and 2·5 in trunk (46). Interorbital (2) less than eye (2·5). No filament over eye. Operculum with radiating striae but without keel.

Superior ridges of trunk and tail discontinuous. Inferior ridges of trunk ending near vent and discontinuous with inferior ridges of tail. Median ridge of body descending over anal to join inferior tail-ridge. A ventral carina. Thus corresponds with no. 5 of Duncker's system. General characters as described for *Yozia bicoarctata brevicauda* Castelnau (in Austr. Zool., xi, 1948, p. 269, fig. 6), but differing in formulae and proportions. Trunk swollen ventrally. Body 7-angled. Vent normal. A small caudal fin present.

Life-colours chocolate-brown nearly all over, lighter below belly, and with few yellow streaks or spots on body anteriorly. Colours change on the head with the pulsating of the gill-chambers. Eye coppery with about 10 or 12 dark brown spots on iris. Fins whitish.

Described from the unique holotype, about 192 mm. or 7½ inches long; Austr. Mus. regd. no. IB. 1665.

Loc.—Pyrmont, Sydney, N.S. Wales, 9th May, 1945.

Differs from other species of *Yozia* in its formulae, proportions, and colourings.

Histiogamphelus briggsii orae, subsp. nov.

D. 25; P. 12; C. 9. Rings 21 + 35. Subdorsal rings 6 + 2.

Head (11 mm.) 3·8 in preanal length (42). Snout (5) 2·2 in head. Eye (3) 1·7 in snout. Tail (55) longer than head and body (42). Caudal fin (4) nearly 3 in head.

General characters as in McCulloch's description of *H. briggsii* (Austr. Zool., i, 1914, p. 30 and fig.) but differing in having a short keel anteriorly on operculum, eye less than two in snout, as well as in other proportions.

Colour, brownish or tan, without blue spots. A smudged, small, dark brown spot on most rings at the ridges. Lips and nostrils yellow. Dorsal base purplish-brown; pectoral base brown, the fins themselves plain whitish. Caudal dark brown tipped with cream.

Described from the unique holotype of the subspecies, a specimen 97 mm. in total length or about 3¾ inches. Austr. Mus. regd. no. IB. 84.

Loc.—Thompson's Bay, Coogee, near Sydney, New South Wales; Mr. A. K. Carter, 1939.

Family MELANOTAENIIDAE.

Quiris, gen. nov.

Orthotype, *Quiris stramineus*, sp. nov.

A genus of freshwater atherines from the Northern Territory of Australia similar to *Telmatherina* Boulenger, 1897, and *Paratherina* Aurich, 1935, from Celebes and *Charisella* Fowler, 1940, from New Guinea, but easily distinguished by the remarkable labial dentition exterior to the jaws, as described below.

Other diagnostic characters are the few short gill-rakers, the somewhat anterior insertion of the anal fin, the robust form, the presence of a silvery lateral band, a single row of cheek-scales, the filamentous dorsal spines and the 33 vertebrae.

Quiris stramineus, sp. nov.

(Figure 3.)

D. vii/i, 9; A. i, 11; P. 14; V, i, 5; C. 15 branched rays. About 28 scales along body. Tr. 6. Pred. 10.

Head (15·5 mm.) 3·4, depth (18) 3 in standard length (54). Eye equals snout (5), less than interorbital (6) and postorbital (5·5). Longest dorsal spines 19 mm.; width at pectoral base, 9; pectoral, 10; predorsal length, 24; depth of caudal peduncle, 7; its length, 8.

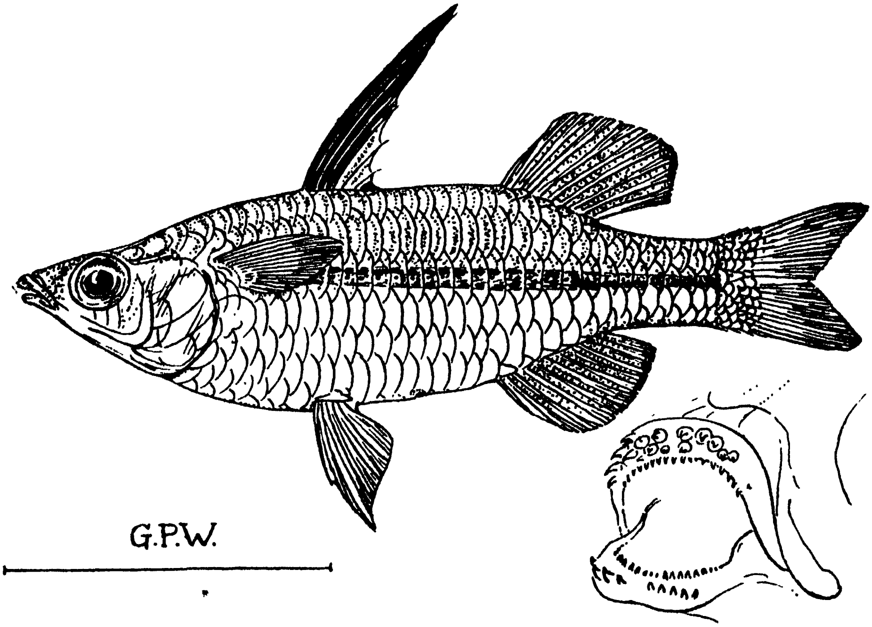


Figure 3.—*Quiris stramineus* Whitley. Holotype from Katherine River, Northern Territory.
G. P. Whitley del.

Snout jutting slightly over preorbital. Premaxillary protractile, pedicles about half eye. Maxillary bluntly hook-shaped, slipping under preorbital. Upper lip overhanging lower. Mouth-opening small, oblique, bordered by premaxillaries and mandibles, broadly arched, descending steeply at sides, not markedly notched. Mandibular rami gently rising. Mouth not quite reaching below eye.

Short strong hook-like teeth in upper and lower lips exterior to jaws in 1 to 3 rows. A single series of pointed, slightly movable teeth around front of each jaw. Vomer with two weak ridges, toothless. Tongue with convex margin, spatulate, toothless. One row of cheek scales. Mucus-pores on head inconspicuous. Nostrils small, oval. Ten or less opercular scales. Gill-membranes free from isthmus. Five over nine short gill-rakers on first branchial arch, much shorter than gill-fringes. Small pseudobranchiae present. Ventral profile of head rounded, not keeled.

Form compressed, robust, broadest behind head. Ventral profile more convex than dorsal. Body covered by cycloid, slightly crenulated scales. A distinct silvery lateral band. Lateral line scales somewhat enlarged and truncate, each with simple pore, and with notches between the four basal radii. Scales do not extend onto fins except a little on bases of paired fins and caudal. Axillary ventral scales above and a lanceolate interventral scale. Four scales between vent and anal origin and 3½ between pectoral base and middle of chest. Vent between ends of adpressed ventrals, in posterior half of distance between snout and caudal and about below hind-border of first dorsal base. Caudal peduncle slightly shorter than anal base.

First dorsal fin with seven long flexible spines, its origin behind level of origin of ventrals, before level of vent, and much nearer snout than root of caudal. Second dorsal with one short spine preceding the branched rays, its origin behind level of that of anal. The latter fin has one feeble spine and eleven branched rays. Second dorsal and anal rounded, not elevated anteriorly as in *Pseudomugil.* Pectoral small, the third ray longest. Caudal forked. Vertebrae (in a paratype) $17 + 16 = 33$, the precaudal and caudal portions equal.

Colour, in alcohol, straw-yellowish, browner above head and on predorsal area. Snout, lips and chin dusky. Upper scales with brown punctate margins. Most of first dorsal membrane blackish, some white near its base posteriorly. Other fins faintly punctulate on their membranes, darkest on second dorsal and along anal margin. Eye bluish. A silvery-blue lateral stripe along middle of lateral line scales. Peritoneum silvery and blackish.

Described and figured from the holotype, largest of five specimens, 60 to 66 mm. (2·6 in.) in total length (Austr. Mus. regd. no. IB. 2149). Also one paratype (IB. 2150) in Austr. Mus. and three paratypes in Mr. Melbourne Ward's Gallery of Natural History and Native Art, Medlow Bath, New South Wales.

Loc.—Katherine River, Northern Territory; Mr. Eric Worrell, 1945; fresh water.

Variation in paratypes: D. vi–vii/i, 9–10; A. i, 10; scales along lateral band, 28–29.

Family SCOLOPSIDAE.

Genus **Scaevius** Whitley, 1947.

Scaevius milii (Bory).

(Figure 4.)

Cantharus milii Bory de St. Vincent, Dict. Class. Hist. Nat., iii, 1823, p. 160, pl. xc, fig. 3. Shark's Bay, W. Australia.

Maenoides cyaneo-taeniatus Richardson, Icon. Pisc., 1843, p. 8, pl. v, fig. 1. Depuch Is., north-western Australia.

Scaevius nicanor Whitley, Austr. Zool., xi, 2, June, 1947, p. 142. Shark's Bay, W.A.

Here figured from the holotype of *Scaevius nicanor*, which appears to be conspecific with the two other species listed above and which were described from paintings which showed colours but only indefinite structural features, so that fresh specimens observed in the field were necessary before the generic position could be determined. *Cantharus dubia* Bory (op. cit., p. 160, pl. xc, fig. 2), imperfectly described from Shark's Bay, may replace *Pentapodus vitta* Quoy & Gaimard, whilst *C. milii* Bory (ibid., pl. xc, fig. 3), which has been associated with *vitta*, appears more like *cyaneotaeniatus* and *nicanor* and is the earliest name for this species.

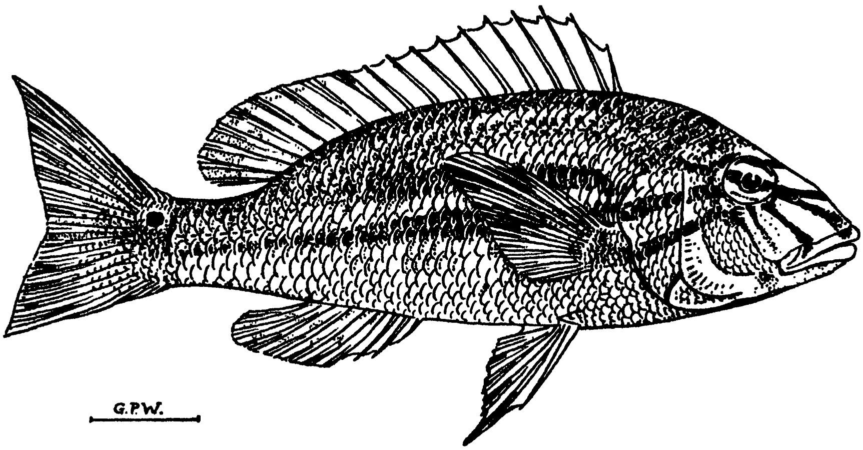


Figure 4.—*Scaevius milii* (Bory). Holotype of *S. nicanor* Whitley from Shark's Bay, Western Australia.

G. P. Whitley del.

Family POMADASIDAE.

Genus **Pomadasys** Lacepede, 1802.

Subgenus **Pristipomus** Bosc, 1819.

Pomadasys (Pristipomus) auritus (Cuv. & Val.).

(Plate xvii, figure 2.)

Pristipoma auritum Cuv. & Val., Hist. Nat. Poiss., v, 1830, p. 263. Siam. *Id.* Cantor, Journ. Asiat. Soc. Bengal, xviii, 1850, p. 1058. *Id.* Gunther, Cat. Fish. Brit. Mus., i, 1859, p. 293. *Id.* Duncker, Mitth. Naturh. Mus. Hamburg, xxi, 1904, p. 149.

Pomadasys auritus Bleeker, Atlas Ichth., viii, 1876, p. 31. *Id.* Chevey, Inventaire faun. ich. Indo-Chine, 19e note, 1932, p. 23 (not seen). *Id.* Weber and Beaufort, Fish. Indo-Austr. Archip., vii, 1936, p. 408.

Pomadasys argenteus (part) Fowler, Bull. U.S. Nat. Mus., 100, xi, 1931, p. 311 (*auritum* regarded as syn. of *argenteus*).

D. xi, 1, 14; A. iii, 7; P. 17; V. i, 5; C. 15. L. lat. 42 to hypural + 6 on tail. Tr. 5/1/12 at dorsal origin to 2½/1/3 on caud. ped. About 32 predorsal scales.

Head (184 mm.) 2·4, depth (*c.* 144) 3·1 in standard length (450). Eye (24) 7·6, interorbital (41) 4·4, snout (46) 4 in head.

Eye to end of opercular flap, 115 mm.; upper jaw, 43; longest (fourth) dorsal spine, 70; height of second dorsal, 50; second anal spine 76 long by 9·5 wide; pectoral, 122; ventral fin, 86; ventral spine, 60; greatest width (at operculum), 76; depth of caudal peduncle, 42. L.C.F. 510 mm. Total length 21 inches.

No pronounced bulge over eye. Anterior profile fairly straight, becoming convex before dorsal fin. Interorbital broadly and slightly convex, exceeding eye-diameter. Operculum half length of head, being produced backwards as a rounded and bulging lobe with its flap extending above about one-third of pectoral fin. Preoperculum with a similar lobe below but with narrow roughened margin. Seven rows of cheek-scales plus about ten more along preopercular lobe. Two small pores and a central groove below chin. No barbels. Maxilla mostly concealed by preorbital, reaching below the large nostrils. Upper jaw the longer. Bristle-like teeth along jaws; none on palate. (The gills have unfortunately been removed.)

Form tapering, rather sciaenoid, and much slenderer than in *P. hasta* of comparable length. Scales large, with narrow rim of fine apical ctenii and about 13 incomplete basal radii, only a couple of which extend to posterior edge of scale-root. Eight scales above l. lat. anteriorly and three posteriorly.

Dorsals deeply notched, the last spine notably longer than the penultimate. Second anal spine much enlarged, more than twice as long as eye. Fins with scaly sheaths at bases. Pectorals and ventrals pointed. Caudal bilobed.

General colour in formalin silvery, greyish above, with some blue and pink reflections on head. Iris gold and yellow. Upper part of snout and front of jaws brown. Cheeks with brown dots and yellow markings. Inside of mouth whitish. Opercular flap brownish-grey. Caudal brown, darker posteriorly. Other fins yellowish except the dorsals, which are dirty white to greyish with narrow dark grey to blackish margins and with 3 to 7 rows of dark grey spots along their membranes. Similar purplish-grey spots are disposed over the back of the fish, ceasing at level of operculum, and mostly occurring at the tip of each scale; a similar spot at top of pectoral base, the axil of which is otherwise plain yellowish.

Described and figured from a gutted specimen, 21 inches long, and thus evidently of record size. Austr. Mus. regd. no. IB. 2153.

Loc.—Newcastle harbour, New South Wales; found floating half-dead by Mr. Athel D'Ombrain early in July, 1948.

New record for Australia.

Family TOXOTIDAE.

Genus **Toxotes** Bosc, 1816.

Toxotes Bosc, Nouv. Dict. Hist. Nat., ed. 2, ii, Sept., 1816, p. 442. Haplotype, "*Labrus jaculator* Shaw", i.e. *Sciaena jaculatrix* Bonnaterre, Tabl. Encycl. Meth., Ichth., 1788, p. 121, from Batavia.

Trompe Gistel, Naturg. Thierr. hoh. Schulen, 1848, p. 109. Substitute for *Toxotes*.

The following nominal species of *Toxotes* have been described: *T. antiquus* Agassiz, 1835; *T. beauforti* Sanders, 1935; *T. blythii* Boulenger, 1892 (syn. *T. microlepis* Blyth, 1861, *non* Gunther, 1860); *T. carpentariensis* Castelnau, 1878; *T. chatareus* (Ham.-Buch., 1822); *T. jaculator* (Bonnaterre, 1788) with syn. *schlosseri* (Gmelin, 1789) and var. *malaccensis* Cantor, 1850; *T. lorentzi* Weber, 1911; *T. microlepis* Gunther, 1860; and *T. oligolepis* Bleeker, 1876.

From these certain Australian Archer Fishes differ, notably in their fin- and scale-counts, proportions and coloration, as defined below.

Toxotes dorsalis, sp. nov.

(Figure 5.)

This new name is provided for the Australian Archer Fish, which has hitherto been called *T. chatareus* by some authors. The latter is an Indian species, originally described as *Coius chatareus* by Hamilton-Buchanan (Acc. Fish. Ganges, 1822, pp. 101 and 370, Pl. xiv, fig. 34) and his figure shows a deeper fish with dorsal fins more peaked and different colour-pattern from the new Queensland form. Later figures by Bleeker, Agassiz, Fowler, H. M. Smith, Weber and Beaufort and others also show true *chatareus* as having the last dorsal spine longer than the first dorsal ray and a blotch on posterior dorsal rays, whereby they differ consistently from Queensland fishes, in which the fifth dorsal spine is shorter than the first ray, whose height is nearly half length of soft dorsal base. The specific characters are as follows:

D. v, 14; A. iii, 17; P. 12; C. 15. L. lat. 35; l. tr. 5/1/11; predorsal sc. c. 25.

Head (54 mm.) nearly 3, depth (67) 2·3 in standard length (160). Eye (12) 4·5, interorbital (20) 2·7, snout (14) 3·8, pectoral (44) 1·2 in head.

General characters as in Weber and Beaufort's account of *T. chatareus* (Fish. Indo-Austr. Archip., vii, 1936, p. 203, fig. 53, A–C). Rostro-dorsal profile slightly convex.

Anal base shorter than that of the two dorsals. Dorsal origin nearer caudal than snout and over tip of pectoral. Gill-rakers 0/1/5. Longest (third) dorsal spine (22·5 mm.) one-third of depth of body below it, and much shorter than head without snout. Fifth dorsal spine shorter than first ray.

Colour, in alcohol, yellowish on sides and below, dusky brown above. Six to seven conspicuous dark greyish-brown blotches along side between eye and upper caudal peduncle. First dorsal, pectorals and ventrals yellowish. Soft dorsal and anal mostly dark grey, their posterior rays pale yellowish and not blotched. Caudal dark grey.

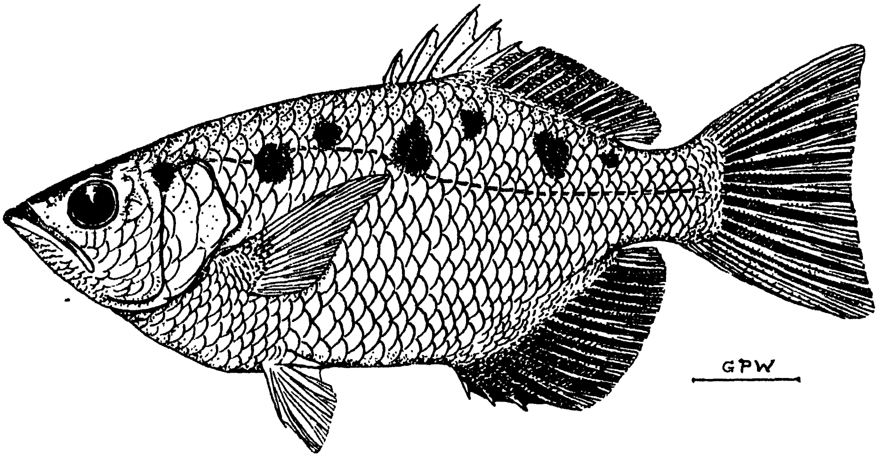


Figure 5.—*Toxotes dorsalis* Whitley. Holotype from Flinders River, Queensland.
G. P. Whitley del.

Described and figured from the holotype, 160 mm. in standard length, L.C.F. 200 mm., or 8 inches overall. Austr. Mus. regd. no. I. 13056.

Loc.—Flinders River, near Hughenden and Richmond, Queensland (Leichhardtian fluvifaunula); Mr. F. L. Berney, 1914.

This species ranges from north-western Queensland across the Northern Territory to north-western Australia, but there are probably subspecies, races or separate stocks in different localities. Typical Flinders River specimens have D. v, 13–14; A. iii, 17 (18); L. lat. 35 or 36 and Tr. 4–5/1/10–12, their scales being more numerous than in Northern Territory specimens.

Many paratypes are in the Australian Museum from the Unsley River near its junction with the Copperfield River, Queensland; and from Mataranka, Roper River, the Katherine River and the environs of Darwin in the Northern Territory. Waite's *Toxotes* sp. from "Mandurah, Western Australia" appears to represent another form and there are allied races or subspecies yet to be described from New Guinea.

Toxotes ulysses, sp. nov.

(Plate xvii, figure 3.)

Toxotes chatareus Steindachner, Denkschr. Akad. Wiss. Wien, xli, 1, 1879, p. 3 (Cleveland Bay, Queensland). *Id.* Klunzinger, Sitzb. Akad. Wiss. Wien, lxxx, 1, 1879, p. 364. Not *Coius chatareus* Ham.-Buch., 1822.

Toxotes sp. Paradice, Quart. Rev. Health Insp. Assoc. Austr., iv, 3, 1926, p. 48 and fig. (Queensland).

? *Toxotes chatereus* (sic) Carr, N. Qld. Nat., xv, 84, 1947, p. 4; Shipway, *ibid.*, xv, 85, 1947, p. 9 and fig. (Barron River, Queensland).

D. v, 12; A. iii, 16; P. 13. L. lat. 29. Tr. 4/1/10 to 4/1/3 on caudal peduncle. Predorsal sc., *c.* 22.

Head (72 mm.) 2·7, depth (95) 2·0 in standard length (196). Eye (15) 4·8, interorbital (27) 2·6, snout (23) 3·1, pectoral (57) 1·2 in head.

General characters as in preceding species. Rostro-dorsal profile concave over eye, convex posteriorly. Anal base equal to base of two dorsals. Dorsal origin over extreme tip of pectoral. More than five gill-rakers. Longest (fourth) dorsal spine (*c.* 37 mm.) about 2½ in body below it and little exceeding postorbital. Fifth dorsal spine slightly longer than first dorsal ray. Caudal subequal to postorbital. Axillary ventral scale covered with smaller scales.

Colour, in alcohol, yellowish on sides and below, dusky-brown above. Five or six conspicuous dark greyish-brown blotches along sides between eye and upper part of caudal fin; of these, three blotches over the body are very large and round, larger than eye. First dorsal, pectorals and ventrals yellowish. Soft dorsal and caudal dirty yellowish. Anal grey, with lighter yellow tinge on spines and last rays. No conspicuous dark blotches on fins.

Described from the holotype, 196 mm. in standard length, L.C.F. 235 mm. or 9·6 inches overall. Austr. Mus. regd. no. IA. 2220.

Loc.—Townsville, Queensland, 8th October, 1924; Surgeon-Lieut. W. E. J. Paradice, R.A.N. Probably lives in brackish water and enters the Jardinean fluvifaunula. In his diary Dr. Paradice noted: "*Toxotes* present in twos or fours at Townsville every visit until end of October. Then never seen (cool change). Present at Hinchinbrooke in September." The Australian Museum has smaller paratypes from Cardwell (no. I. 249) and Cairns (IB. 43), with D. v, 12–13; A. iii, 16–18; Sc. *c.* 26–29; Tr. 4/1/10; base of dorsals less than that of anal in young.

T. ulysses is distinguished from *dorsalis*, its nearest ally, by its larger scales, different proportions, concavity in profile over eye and larger blotches on body. Dorsal and anal bases subequal in larger specimens.

Protoxotes, gen. nov.

Orthotype, *Toxotes lorentzi* Weber.

The most primitive of the Archer Fishes, the type-species has very small scales, about 46 in l. lat., and seven or eight scales between first dorsal spine and l. lat. The dorsal origin is further forward than in *Toxotes* and the l.lat. is not inflected anteriorly. No dark stripes or blotches on body.

Protoxotes lorentzi (Weber).

Toxotes lorentzi Weber, Notes Leyden Mus., xxxii, 1911, p. 232. Near Merauke, Papua.

Id. Weber and Beaufort, Fish. Indo-Austr. Archip., vii, 1936, p. 198, fig. 52 (refs.).

Two specimens, 5¼ to 5½ inches long, were collected by A. Morton in Yam Creek, Northern Territory, more than thirty years before Weber described the species from New Guinea. Austr. Mus. regd. nos. A. 4812–3.

New record for Australia.

Key to the Australian Archer Fishes.

A. L. lat. about 46, running straight. Dorsal origin nearer snout than end of tail. D. v, 13-14. Head and body without blotches .... *Protoxotes* (gen. nov.) *lorentzi.*
AA. L. lat. less than 40, with anterior inflection. Dorsal origin nearer end of tail than snout or mid-way. Head and body with dark bands or blotches.
  B. Four dorsal spines .... *Toxotes jaculator.*
  BB. Five dorsal spines.
    C. L. lat. more than 30 .... *T. dorsalis,* sp. nov.
    CC. L. lat. 30 or less.
      D. Five bands across body .... variety from "Mandurah".
      DD. Round blotches on body .... *T. ulysses,* sp. nov.
  BBB. Six dorsal spines (fide Castelnau) .... *T. carpentariensis.*

Family GOBIIDAE.

Rewa, gen. nov.

Orthotype, *Rewa hicklingi*, sp. nov.

A small river goby from Fiji which seems unlike anything known to me in literature or collections. Superficially it seems like *Bryanina* Fowler (Occ. Pap. Bish. Mus., ix, 1932, p. 10) from Tahiti and the Marquesas, and like *Gobius graeffei* Gunther, 1877, from Namusi, Fiji, which is an *Aboma*, but is different.

Snout bluntly rounded. Lips toothless, the upper one thick. Mouth small, reaching below front of eye, its cleft oblique. Tongue not notched. Teeth microscopic. No pit above opercle; papillae not apparent, no barbels or orbital cirrhus. Chin rounded but not jutting.

Body rather elongate, compressed, more so posteriorly, where it is deep between dorsal and anal fins. Shoulder-girdle not lobed. Scales ctenoid. Trunk not naked anteriorly. No anal papilla.

First dorsal fin with five or six slender spines, well separated from second. Soft dorsal and anal free from the somewhat pointed caudal. Pectoral base muscular, the fin pointed, without free silk-like rays. Ventrals five-rayed, united as a short, circular, flat (not cup-shaped) sucking-disc, adnate to abdomen anteriorly.

Rewa hicklingi, sp. nov.

D. v or vi/i, 10; A. 10; Sc. *c.* 33. Tr. 9 between soft dorsal and anal. About 10 predorsal scales.

General characters as defined for genus.

Colour, pale green with dark chromatophores crossing sides posteriorly; two dark marks before base of tail. Two median dark lines from vent converge and join below caudal peduncle. A row of spaced blackish dots each side of second dorsal fin. A dark internal smudge near beginning and end of anal fin. Groups of black dots on snout, cranium and elsewhere. No bands on head or body and no dark bases to paired fins.

Holotype (Austr. Mus. regd. no. IB. 1949) and seven paratypes (IB. 1950–1951), up to 32 mm. in total length.

Loc.—Rewa River, Fiji, 2nd and 3rd July, 1947. Collected by Dr. C. F. Hickling, Fisheries Adviser to the Colonial Office, London, after whom I have pleasure in naming the species.

EXPLANATION OF PLATE XVII.

Figure 1.—*Odontaspis herbsti* Whitley. Lateral view of holotype from off Gabo Island, New South Wales.

Figure 2.—*Pomadasys auritus* (Cuv. & Val.). A specimen from Newcastle, New South Wales.

Figure 3.—*Toxotes ulysses* Whitley. Holotype from Townsville, Queensland.

Photos, Howard Hughes.

A RE-EXAMINATION OF AN UPPER PERMIAN INSECT, *PARAKNIGHTIA MAGNIFICA* EV.

By J. W. EVANS, Sc.D.

(Figures 1–15.)

In the Permian strata of America, Russia and Australia there have been found abundant remains of insects belonging to the sub-order Homoptera. However, up to the present not a single undoubted representative of the Heteroptera has been described from either the Permian or the Carboniferous. It is true that the figure of the forewing of *Phthanocoris occidentalis* Scudder from the Carboniferous of America suggests that of an insect belonging to the Heteroptera, but Handlirsch (1908) was of the opinion that the apparent division of the wing into corium and membrane was due to a fracture in the underlying rock.

A few Heteroptera have been described from the Triassic. These include *Dunstania pulchra* Tillyard, *Dunstaniopsis triassica* Tillyard (1918) and *Triassocoris myersi* Tillyard (1922). Handlirsch has figured several from the Jurassic, the most convincing being *Archegocimex geinitzi* Handlirsch and *Eocimex liasinus* Handlirsch.

While much has been written about the relationships of the two sub-orders of the Hemiptera to each other, their relative antiquity and their origin, little more can be surmised than that both arose during Carboniferous times and that their common ancestor did not survive into the Permian epoch. If this surmise is correct, then it can be expected that Heteropterous remains will occur in Permian strata.

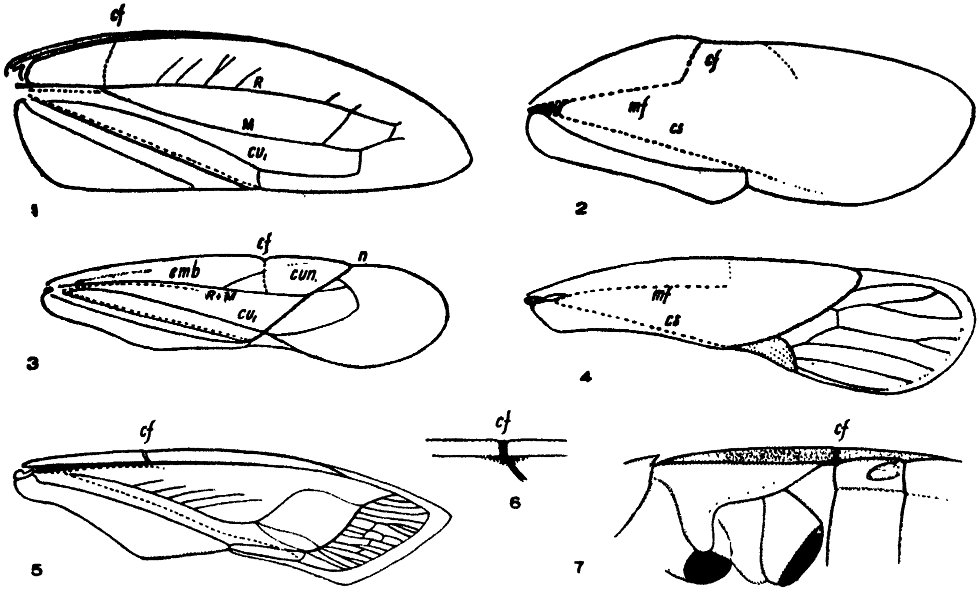
It is the purpose of this paper to suggest that an insect, formerly described from the Upper Permian of Lake Macquarie, New South Wales, as a Homopteron belonging to the family Ipsviciidae, and named *Paraknightia magnifica* Ev., is in reality a representative of the sub-order Heteroptera. (Evans, 1943.)

The principal features in which the Homoptera differ from the Heteroptera are associated with the head. The wings, especially the forewings, are also distinctive, both in the manner in which they are folded as well as in their texture and venation. While in the Homoptera the wings are usually carried roof-wise over the body, in the Heteroptera they lie flat and overlap apically. In texture, those of the Homoptera are either entirely membranous or entirely coriaceous, while the forewings of most Heteroptera are coriaceous basally and membranous apically.

Fossils do not provide evidence relating to wing position. It thus would seem that the only criterion for the determination of the correct sub-order from evidence provided by wings (assuming that characteristic venational features are lacking) is the presence or absence of a transverse line dividing the corium from the membrane. Even such a dividing line may not provide positive evidence, since there are some Homoptera belonging to both extinct and recent forms, which have a similar line, the nodal line. Nevertheless there exists a feature common to the forewings of many Heteroptera which is entirely lacking in those of the Homoptera. This feature is the costal fracture.

The costal fracture is a transverse line of weakness which extends from the costal margin of the hemielytron as far as the median furrow, or as far as vein R + M. The area of the wing thus separated from the remainder is known as the embolium (Figs. 2, 3).

An embolium is usually regarded as a special characteristic of the Miridae and Anthocoridae, but it occurs also in insects comprised in several other families of the Heteroptera. It is especially well developed in the Naucoridae (Fig. 2, *Pelecoris* *carolinensis* Bueno); in the Belostomatidae (Figs. 5, 6, *Lethocerus annulipes* H.S., Fig. 7, *Belostoma minor* Dufour); in the Ochteridae (Fig. 8, *Ochterus marginatus* Latr.); in the Notonectidae (Fig. 9, *Notonecta uhleri* Kirk.); and in the Velocipedidae (Fig. 10, *Scotomedes alienus* Dist.). It is present also in the Corixidae (Abbott, 1923) and in the Nepidae, Gelastocoridae, Mononychidae and Helotrephidae, and in the last-named family has been referred to by Esaki and China (1928) as the "clavulus". In the Cryptostemmatidae, although the median furrow is obsolete, the costal fracture may be retained, as is the case in *Cryptostemma sordida* China (China, 1946). Sometimes the embolium is clearly differentiated although the costal fracture is indistinct; for instance, in the Pentatomid, *Bathrus variegatus* Dist. (Fig. 4).

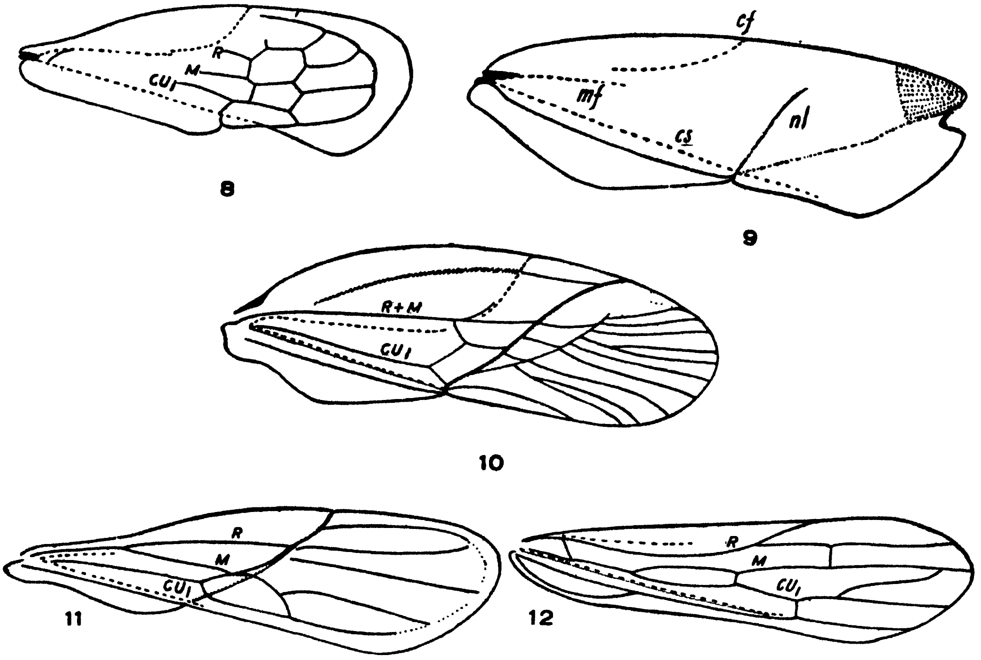


Figures 1-7.

1, (*Paraknightia magnifica* Ev.), forewing. 2, *Pelecoris carolinensis* Bueno (Naucoridae), forewing. 3, *Lygus vanduzei* Knight (Miridae), forewing. 4, *Bathrus variegatus* Dist. (Pentatomidae), forewing. 5, *Lethocerus annulipes* H.S. (Belostomatidae), forewing. 6, *L. annulipes*, margin of forewing. 7, *Belostoma minor* Duf. (Belostomatidae), ventral surface of thorax, abdomen and forewing, in part. *Cf.*, costal fracture; *mf.*, median furrow; *cs.*, claval suture; *emb.*, embolium; *cun.*, cuneus; *nl.*, nodal line.

The term "embolium" has been given different meanings by different authors. Some have used it in the sense employed above (Comstock, 1918; Usinger, 1937, 1938). On the other hand, China and Myers stated: "Venationally the embolium may be defined as that part of the corium between R + M and the actual anterior margin, formed by the turning over of the true costal margin . . . it is a specialized unit comparable to the clavus and cuneus." Two misinterpretations are inferred in this statement. First, the embolium has nothing to do with venation, as the median furrow and not R + M forms its posterior boundary. Secondly, the cuneus is not a specialized unit; it is no more than that part of the corium which lies between the costal fracture and the nodal furrow. As pointed out by China and Myers, yet another interpretation of the embolium was given by Knight (1923), who used the term to define a narrow costal border of the hemielytron of Mirids, which is limited posteriorly by an indistinct Sc. The same authors also mention that Reuter (1910) called the costal border, which in *Pyncoderes* spp. and certain other Mirid genera is cut off from the rest of the corium by a deeply impressed furrow, the embolium. In the Miridae a true embolium is best represented in forms such as *Monalocoris parvulus* Reut., a species which has been figured by China (1938).

Of the Permian Hemiptera described by me in 1943, the most striking and best preserved specimen was the one which was given the name *Paraknightia magnifica*. Both forewings of this fossil are preserved, and as well the pronotum, scutellum and the abdomen, the last-named with a well-developed ovipositor. The forewings show no trace of a nodal furrow, a feature which would immediately have suggested Heteropterous relationships, but they have on the other hand a distinct costal fracture. In the original description the fracture was called the nodal line, and although it was pointed out that it was not homologous with the nodal line of other Homoptera, its true significance was not appreciated.

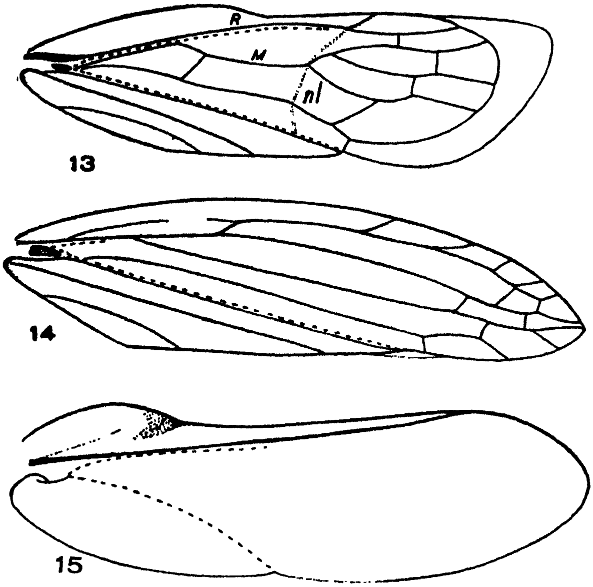


Figures 8-12.
8, *Ochterus marginatus* Latr. (Ochteridae), forewing. 9, *Notonecta uhleri* Kirk. (Notonectidae). 10, *Scotomedes alienus* Dist. (Velocipedidae). 11, *Oncopeltus varicolor* F. (Lygaeidae). 12, *Dicephalus telescopicus* Kirby (Henicocephalidae).

The forewing of *P. magnifica*, which is 12 mm. long, is illustrated in Figure 1. The illustration is of the lower and not of the upper surface of the wing, as is the case with all the other figures. The median furrow cannot be distinguished in the fossil impression, but it is probable that it occurred as indicated in the figure, since this is its most usual position in relation to R + M.

The tegmina of Homoptera lack a costal fracture and seldom have a well-developed median furrow. In this sub-order a median furrow is best retained in the archaic Hylicidae (Fig. 13, *Balala fulviventris* Walk.), in which it is incorporated basally in R + M but is distinct distally. The more usual mode of occurrence in the Homoptera is illustrated in Figure 14 (*Poophilus adustus* Walk., Cercopidae), where the furrow does not extend even as far as the junction of R and M. In the Heteroptera also the median furrow is sometimes poorly developed, as for instance in the Lygaeidae (Fig. 11, *Oncopeltus varicolor* F.).

The other characteristic feature of the forewings of Heteroptera, the nodal furrow, is lacking in some representatives of this sub-order. Thus it is absent in some Ochterids (Fig. 8, *Ochterus marginatus* Latr.), Saldids, Gerrids and Naucorids. It is not present in any representatives of the family Henicocephalidae (Fig. 12, *Dicephalus telescopicus* Kirby). It is interesting to note that in the forewings of representatives of the Henicocephalinae the median furrow is anteriorly placed in relation to R. Usinger (1932) at one time believed this furrow represented the remains of Sc; later (1945) he altered his views on the venation of the Henicocephalidae, and now is of the opinion that Sc lies along the costal margin of the wing and that the vein labelled R in Figure 12 is vein R + M.



Figures 13-15.

13, *Balala fulviventris* Walk. (Hom., Hylicidae), tegmen. 14, *Poophilus adustus* Walk. (Hom., Cercopidae), tegmen. 15, *Panesthia javanica* Serv. (Orth., Blattidae).

It is evident, therefore, that the lack of a nodal furrow need not prevent the inclusion of *P. magnifica* within the Heteroptera.

The venation and shape of the wing must now be taken into account, but although a study of the venation yields no positive evidence, the manner of the reduction of the veins and the fact that they are obscure apically certainly suggests an approach to the heteropterous condition. In shape and in the size of the clavus they resemble recent Homoptera rather than Heteroptera. So far as the embolium is concerned, it is almost certain that the embolium of *P. magnifica* is homologous with those of recent Heteroptera, but the origin and the function of this development of the forewing is problematical.

A search in other orders of insects for a development similar to the costal fracture yields little result, the only comparable one being the nodus of the wings of Odonata. If, however, the embolium is regarded as an area of the wing which is limited posteriorly by an alar suture, comparison is possible with the forewings of certain Orthoptera.

Figure 15 represents the forewing of a cockroach, *Panesthia javanica* Serv., and in the figure all the veins have been omitted except the radius and an obscure subcosta. Comparison of this figure with Figure 2 reveals a striking correspondence in shape and lines of weakness between the Blattid and the Naucorid. Both wings are divided into three distinct areas by the costal suture (or median furrow) and the claval suture. In the Blattid, only the claval suture reaches the margin of the wing, while in the Hemipteron both sutures reach the margin. It is possible that the costal fracture of Heteroptera may be associated with the mechanics of flight, and the extension of the median furrow to the border of the wing permit of greater flexibility. In recent Heteroptera an embolium is especially associated with those insects which have reduced venation in the corium.

As all the available evidence of a positive nature, with the exception of the shape of the forewing, suggests that *P. magnifica* belongs to the Heteroptera rather than to the Homoptera, it is accordingly transferred to the latter sub-order and a new family, the Paraknightiidae, created for its reception. This family has the following characteristics: pronotum with well-developed lateral paranota; tegmen with a short, but broad, embolium extending as far as the junction of R + M and without a nodal furrow; a well-developed ovipositor in the female.

Already in Upper Permian strata of New South Wales some splendidly preserved heads of small Homoptera have been discovered, while in the Russian Permian the heads of several large Homoptera have been brought to light. If the head of *P. magnifica* were to be discovered, not only would it finally decide the correct sub-ordinal position of this insect, but it might lead as well to a better understanding of the inter-relationships of the two sub-orders of the Hemiptera.

ACKNOWLEDGEMENT.

I am indebted to Dr. W. E. China for constructive suggestions based on his very wide knowledge of the order Hemiptera.

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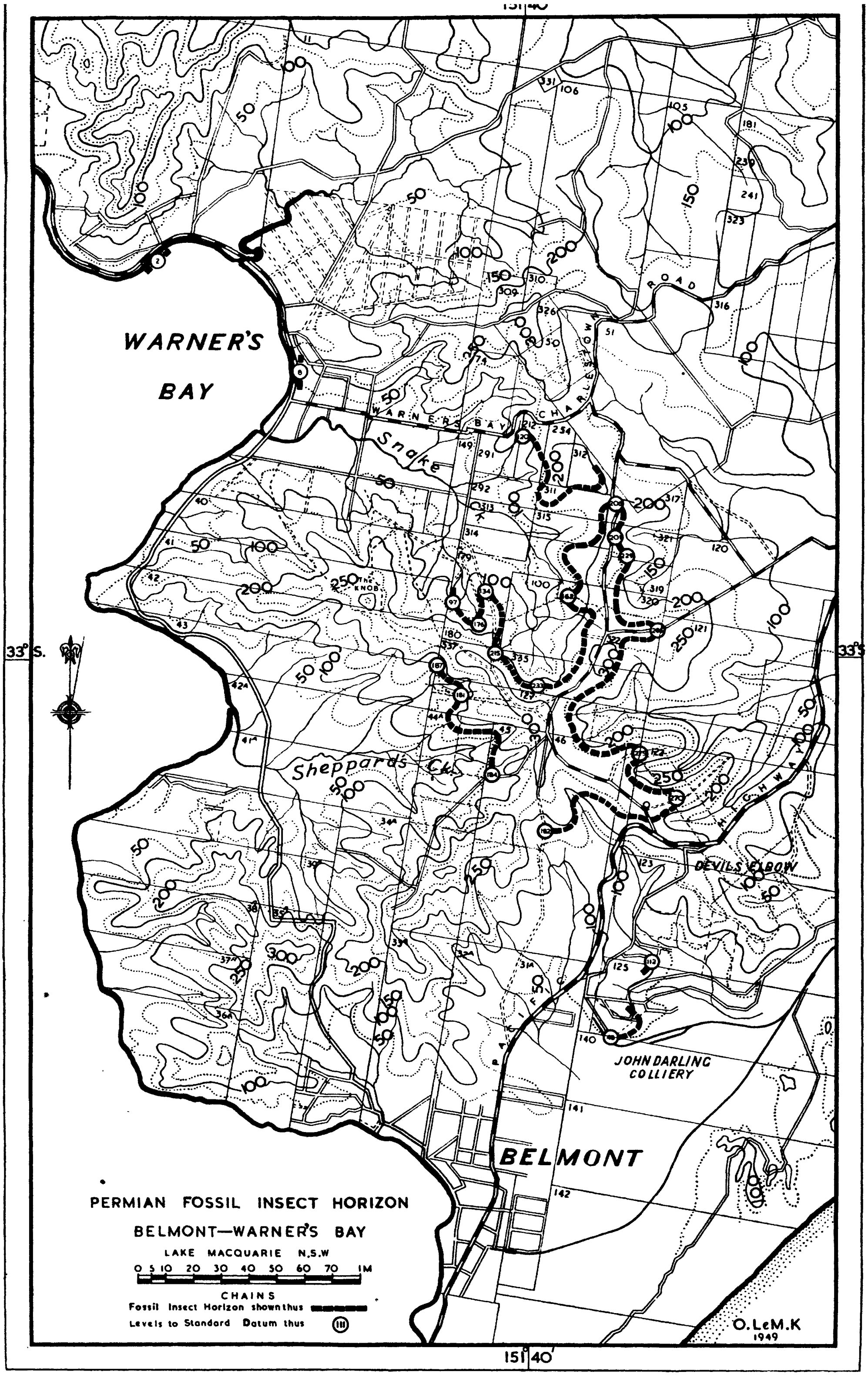

PERMIAN FOSSIL INSECT HORIZON

BELMONT—WARNER'S BAY

LAKE MACQUARIE N.S.W

FOSSIL INSECT BEDS OF BELMONT, N.S.W.

By O. LeM. Knight, B.E., Assoc.M.Inst.C.E., A.M.I.E.Aust.
Hon. Correspondent, Australian Museum.

(One map.)

Fossil insect remains were discovered in the Newcastle Coal Measures in 1898 by Mr. John Mitchell, Principal of the Newcastle Technical College, when a wing, not described and subsequently lost, was found by him in shale overlying the Yard Seam at the base of Flagstaff Hill, Newcastle, and reported in the Proceedings of the Linnean Society of New South Wales, Vol. xxiii, 1898, p. 437.

In 1917 Dr. R. J. Tillyard described a number of wings found by Mr. Mitchell, of which two were found near the Soldiers' Baths, Newcastle, on an horizon just above the Dirty Seam (Proc. Linn. Soc. N.S.W., xlii, 4, p. 721), and in 1921 Dr. Tillyard described a further two wings found by Mr. Mitchell on the railway embankment near Merewether Beach, Newcastle (Proc. Linn. Soc. N.S.W., xlvi, 4, p. 413).

With the exception of these five wings, all the insect remains from the Newcastle Coal Measures have been found on an horizon which was first discovered by Mr. Mitchell in a shallow quarry about two miles north of Belmont, and subsequently traced to other localities between Belmont and Warner's Bay on Lake Macquarie. This horizon has proved to be very prolific in fossil insect remains, and nearly two thousand specimens from it are registered in the Australian Museum collection. Of these, approximately half are represented by the magnificent collection presented to the Museum by Mr. Malcolm S. Stanley in 1943.

During the past three years the writer and Mr. D. Walker have spent such time as was available in mapping the Belmont insect beds and determining their correct relation to the Newcastle Coal Measures. The outcrop is shown by the heavy broken line on the accompanying map.

The original outcrop found by Mr. Mitchell is approximately half a mile north of the John Darling Colliery and a quarter of a mile east of the Pacific Highway at the turnoff to the John Darling Colliery and Redhead. It continues around a low hill to the east of the Highway, and outcrops very prominently at the main gate of the colliery and along its northern boundary.

This eastern outcrop, however, is an isolated one, the main portion of the beds occurring to the west and north of the Pacific Highway.

At the top of Devil's Elbow, on the Pacific Highway, three miles north of Belmont, the beds outcrop about five chains to the west of the highway on the road leading through Violettown to Warner's Bay. This road follows a ridge running north-west for half a mile and then north for another mile and a half, and the insect beds outcrop to the east of the road at distances varying up to 20 chains and at an elevation of 200 to 280 feet above sea level.

West of this road the horizon follows the heads of the gullies feeding Sheppard's Creek and Snake Creek, and crosses the road again about two miles north of the Devil's Elbow.

The dip of the beds is in general W to SW at approximately 3°, but is variable, the strike following roughly the contours of the structural basin of which Lake Macquarie occupies the centre.

In the vicinity of the ridge running east from Rocky Point, at the southern extremity of Warner's Bay and dominated by a hill known as The Knob, a very pronounced vergation in the structural contours indicates local warping with a crest of about 70 feet above the normal horizon.

Isolated outcrops have been found near the shore of Warner's Bay, one at lake level on the northern shore of the bay and one eight feet above mean water level in a cliff on the eastern side of the road skirting the bay, about eleven chains north of the Warner's Bay–Charlestown Road.

The horizon of the beds lies about 70 feet below the bottom of the Fassifern Coal Seam or approximately 270 feet below the upper limit of the Newcastle Coal Measures as given by David (Geological Survey of N.S.W. Memoir, Geology, No. 4, 1907).

The rock in which the insect remains are found is a hard, very fine-grained chert about two feet six inches thick. Stratification is pronounced and well-defined joints cause the chert to break into rhomb-shaped blocks. The colour is light-grey to bluish-grey near its upper surface and becomes black towards the lower boundary. It weathers to a softish white rock stained a pinkish-brown colour on the weathered faces. In some cases the chert is so highly silicified as to be slightly translucent, and all evidence of banding is obliterated. These characteristics are typical, and even when the outcrop material is almost completely disintegrated the presence of the chert outcrop is indicated by small flat fragments of a pinkish colour.

The insect bed is underlain by sandstone for a depth of 15 to 18 feet, beneath which is a very prominent bed of coarse, strongly-cemented conglomerate, consisting of water-worn pebbles, including pebbles of coal. The thickness of this conglomerate is approximately 50 feet.

At a level about 10 feet below the insect bed, fossil wood abounds on the surface wherever the chert has been traced, and this horizon includes sections of fossil trunks up to 18 inches in diameter.

The insect remains are invariably associated with *Leaia* and *Estheria*. Fish scales are plentiful in some localities, though no fossil fish have been found. One specimen of a king crab (*Limulus*) has been reported, but this has not been verified.

The associated fossil plant remains are *Glossopteris*, *Phyllotheca*, and *Noeggerathiopsis* with occasional *Annularia* and *Sphenopteris*. The lower portions of the beds possess a coarse texture and are dirty brown to black in colour. Comminuted plant remains resembling chopped straw are prevalent in this portion of the beds.

Taking into consideration the odds against an insect wing being preserved and against cleavage just where a wing occurs, the number of wings found indicates that the insect population must have been extraordinarily large. Although each wing found represents two to three hours' work, the yield from a cubic foot of the best layers, split in a good light and carefully examined, is estimated at 10 to 20 wings. This can only be a very small fraction of the insect population and yet indicates some hundreds of million wings per square mile of the beds.

No further work has been done on the insect horizon discovered by Mr. Mitchell at Newcastle in the neighbourhood of the Yard and Dirty Seams, nor has the extent of the Belmont insect-bearing beds been determined. Undoubtedly this insect horizon will be found outcropping in the hills to the north-east of Warner's Bay and in the hills to the east of the John Darling Colliery, between the Belmont railway and Nine Mile Beach. It may also be found on the other side of Lake Macquarie in the vicinity of the West Wallsend-Awaba Road, and even further south.

One insect wing has been recorded by W. S. Dun (Journ. Proc. Royal Soc. N.S.W., Vol. xlv, 1911, p. 554) from the roof of the coal seam in the Sydney Harbour Colliery at Balmain, associated with a species of *Taeniopteris*.

Tillyard, in describing this wing (Proc. Linn. Soc. N.S.W., xliii, 2, p. 260) gives its horizon as 600 feet above that of the Belmont beds, which would place it about 300 feet

above the upper limit of the Permian as given by David. Although closely associated with the Upper Coal Measures, it is doubtful whether this insect should be considered a Permian genus.

Permian Fossil Insects from the Newcastle (N.S.W.) Coal Measures.

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A FOSSIL MECOPTERON FROM THE TRIASSIC BEDS AT BROOKVALE, N.S.W.

By E. F. RIEK.

(Plate xviii and Figures 1–4.)

The shale beds at Brookvale have yielded beautifully preserved insect fossils, some of which have been described by Tillyard (1925) and McKeown (1937). In many cases the wing pigmentation pattern has been preserved, as it is in the Mecopterous wings described here. The lithology and horizon of this fossil bed have been outlined in earlier papers, so it is sufficient to restate that they occur in a lens of shale in the Hawkesbury Sandstone Series of Triassic age.

Although there are eleven fossil specimens of Mecoptera, they are all of the one species, representing both forewings and hindwings and portion of the body structure. The only parts not known are the apex of the abdomen and most of the legs. One specimen shows clearly a side view of the head with antennae, and the thorax with portions of the wings. The fossil resembles some of the Liassic Orthophlebiidae very closely but retains a distinct cubito-median Y-vein. It is described in this family as a new genus, *Choristopanorpa*, having characters of both the recent *Chorista* and *Panorpa*, but possibly more closely allied to the latter genus. It is very near *Mesopanorpa* Handlirsch as emended by Martynov, 1927.

Family ORTHOPHLEBIIDAE Handlirsch.

Mesozoic Mecoptera, forewing with a five-branched media similar to that of recent Choristidae; R_s variable, tending to pectination, but R_{4+5} only two-branched; Sc long, almost as long as R_1. Hindwing (based on *Choristopanorpa*) with cubito-median Y-vein absent and M with only four branches; CuP and A_1 fused for part of their length.

Choristopanorpa differs from normal panorpids mainly in the typically five-branched M of the forewing. On rare occasions M is five-branched in recent panorpids.

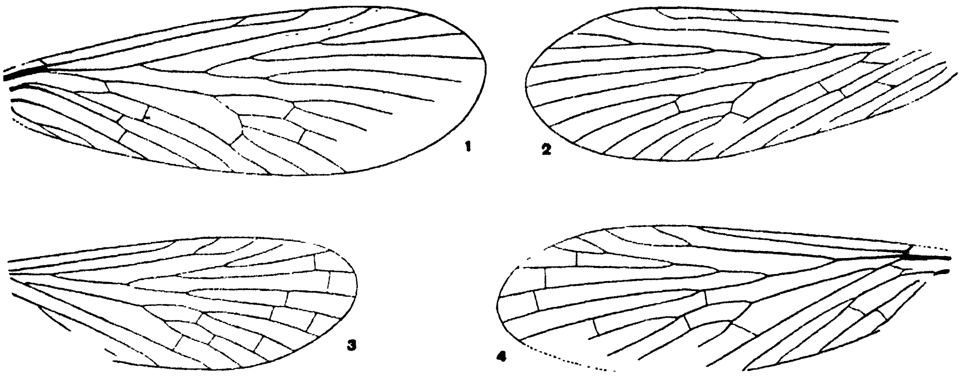
Genus CHORISTOPANORPA nov.

Genotype, *Choristopanorpa bifasciata*, sp. nov.

Forewing with Sc long, reaching into the pterostigma; Rs five-branched, extra fork on R_2, R_{2+3} forking before R_{4+5}; M arising close to base, five-branched, the extra branch on M_4; cubito-median Y-vein well developed; three anal veins, A_3 forked in the genotype. Hindwing with Sc long, simple; R_1 forked near apex, R_s typically five-branched but occasionally six-branched; M four-branched; cubito-median Y-vein absent; CuP and A_1 fused for part of their length. The hindwing is very similar to that of recent panorpids.

Choristopanorpa bifasciata, sp. nov.

Forewing.—Wing rather large, costal space not greatly expanded, apex evenly rounded; Sc long, rather close to the costal margin, ending on the margin within the petrostigma and with a weak branch to the margin from towards its apex; R decidedly curved before the origin of R_s, R_1 curved within the pterostigma; pterostigma well developed, lower margin sharply defined by a distinct pterostigmatic groove almost equidistant from R_1 and R_s; R_s arising in the basal third, R_{2+3} forking slightly before R_{4+5} with R_2 forking again at a level of about the middle of the pterostigma; M arising from R before the humeral cross-vein, forking just after the first forking of R_s, with M_{3+4} forking rather early and then M_4 forking almost immediately, the lower branch of the fork being deflected near its base, where it is connected to CuA by a distinct cross-vein; cubito-median Y-vein very distinct, both arms well developed but that from Cu the longer; CuA with a slight sigmoid curvature towards the wing margin; CuP weak, straight, parallel to CuA over its basal portion. connected to CuA by a cross-vein at about the middle of their lengths; A_1 and A_2 straight except at base, parallel, A_3 forked about its middle, its lower branch short; wing with two cross-bands of dark pigment, the basad one extending over the whole length of the stem of R_s, the distad one from the base of the pterostigma to the apex of the wing, darker over the anterior half. There may be scattered small areas of pigment in between these two distinct bands. The extra fork on R_2 may occur nearer the wing margin than in the type and the cross-vein from M to CuA may pass from the stem of M_4 and not from the lower fork of M_4.



Figures 1-4. *Choristopanorpa bifasciata*, sp. nov.
1, Holotype forewing (F.30959). 2, Forewing (F.39196). 3, Typical hindwing (F.39195). 4, Hindwing F.30964).

Hindwing.—Similar in size and shape to the forewing, but the costal margin is almost straight; Sc long, simple, not quite reaching the pterostigma; R_1 almost straight for most of its length, basal stem of R not curved, apex of R_1 forked within the pterostigma, upper branch shorter and sigmoidally curved, lower branch longer and with a simple, marked curve; R_s arising closer to the wing base than in the forewing, but the branching very similar; M. appears to arise from CuA, no cubito-median Y-vein, only four-branched, forking just after the first forking of R_s, with M_{3+4} forking again rather rapidly; a distinct cross-vein from M_4 to CuA; CuA straight for most of its length, with only a very gentle curve at apex; base of CuP not preserved, fused for some distance with A_1, but the apical two-thirds free, almost parallel to CuA; other anal veins not preserved. The wing pigmentation is similar to that of the forewing, but the middle light area is almost divided transversely by a narrow dark band (also seen to some extent in the forewing).

In a second specimen of the hindwing R_s is six-branched, the extra fork being an end-twigging on R_{2a}; M as in the typical specimen; Cu and anals better preserved; M arises from R at the level of the humeral cross-vein, is fused to CuA for a short distance, and then appears to arise as a branch from CuA; CuA simple; CuP arising from CuA close to the wing base and quickly fusing to A_1 for about a quarter of its length and then continuing as a simple vein to the wing margin; A_1 also simple, A_2 arising from base, simple, A_3 arising from base, only partly preserved, probably forked at about its basal quarter.

The thorax, though crushed, shows a form similar to that of recent *Chorista*, but the face is a little more elongated.

Types.—Holotype forewing F.30959 and paratypes F.30956, a large forewing perfect except for extreme base; F.39196 and counterpart F.39186, a perfect forewing showing variation in the forking of R_s and M_4; F.30967, a large forewing perfect except for the anals; F.39197 shows a lateral view of the head and thorax with antennae and mouth parts and portions of the legs and wings; F.38258 forewings and hindwings partly overlapping and indefinite body remains; F.38263 and counterpart F.35879 with the two wings of each side overlapping and portion of the abdomen showing segmentation; F.30062 a poorly preserved complete wing with a six-branched R_s; F.39181 imperfect overlapping wings with portion of the abdomen; F.39195, the typical hindwing, lacking the extreme base and most of the anals, and F.30964 an almost perfect hindwing with a six-branched R_s.

Type Locality.—Beacon Hill, Brookvale, near Manly, New South Wales.

Horizon.—Lenticular shale in the Hawkesbury Sandstone Series, Middle Triassic.

The hindwing of this species is very similar to that of *Parachorista* from the Upper Permian of Belmont, New South Wales, and would have been placed in that genus had the forewing not been found. The costal space is narrower and the cross-vein from the long Sc to R_1 is not obvious, as it is in *Parachorista*. R_s shows a branching similar in the two, but in *Chrostopanorpa* R_{2+3} forks clearly before R_{4+5}. The origin and branching of M and Cu are similar, but the amount of fusion between CuP and A_1 differs as, too, does the shape of the anal veins.

The forewings of these two genera differ more than do the hindwings. M is only five-branched in *Choristopanorpa*, M_2 being simple and R_s has only the same five branches as in the hindwing, while in *Parachorista* there is typically an extra fork to R_s, but the general plan is the same. Sc is either simple or at least not strongly forked near its apex in *Choristopanorpa*, but in other characters the wings are very similar.

References.

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EXPLANATION OF PLATE XVIII.

Choristopanorpa bifasciata, gen. et sp. nov. × 3 diameters ca. Fig. 1. F.30959, holotype forewing. Fig. 2. F. 39196, forewing variant. Fig. 3. F.39195, typical hindwing. Fig. 4. F.30964, hindwing variant. Fig. 5. F.38263, overlapping fore- and hindwings and abdomen.

REVIEW OF THE RISSOIDAE OF NEW SOUTH WALES.

By CHARLES F. LASERON.
Honorary Correspondent, Australian Museum.

(Figures 1–94.)

INTRODUCTION.

This paper, the second of a series reviewing some of the families of New South Wales mollusca, is based primarily on the collections made by my son John and myself during the last twenty years. When Hedley published his check list in 1917 it was thought that the work of the systematist was nearly completed and that comparatively few species awaited discovery and naming. Since that time, nevertheless, the list has been appreciably enlarged, partially by checking known material, but particularly from new material brought in by trawlers operating on the continental shelf. Even from easily accessible locations on the shore systematic collecting has revealed that a far greater molluscan fauna exists than was ever suspected. This applies particularly to the smaller species which, though often of quite striking character, have in many cases been overlooked. Size is, after all, relative, and actually the species of small shells, say under 5 mm. in length, greatly outnumber those of larger size, while the number of individuals must be very much greater. Thus when the broader problems of marine zoology are considered, the relative importance of minute molluscs must at least be as great as, if not greater than, those of more conspicuous size.

Minute size makes study perhaps a little more difficult, but the student of small shells is fortunate in one way. In the early days of collecting very few found their way abroad, and they have thus escaped the involved synonymy which so obscures the identity of many of the larger species. Most of the known species have been described locally, and the literature and types are accessible to the local student. The contributions of such men as May, Tate, Charles Hedley and others to Australian scientific journals have been most carefully compiled and are of great accuracy. The work of the late Charles Hedley particularly is so clear, careful and accurate that it is a magnificent foundation on which to build.

The chief limitation in the past has been that most of the small material dealt with has been collected from shell sand from the beaches. This, though not without value, is at times worn and faded, and specimens are found in ones and twos instead of in colonies as when procured alive. One can go farther and say that with some groups beach material is practically unidentifiable, yet the same when found alive present very little difficulty at all.

In this paper live material has been dealt with wherever possible. A fruitful collecting ground has been the various algae abundant in rock pools right along the coast. These, if washed in fresh water, yield myriads of small shells which can be sorted out with a lens from the debris. The bottoms of rocks when scrubbed into a basin yield a further harvest, as do also masses of mussels, broken galiolaria tubes, the surface of sponges, and so on. Deeper water material has been obtained by dredging, also by the examination of mud and sand brought up by trawlers from the continental shelf. For the latter I am particularly indebted to Mr. T. Nielsen, of Crookhaven, who has for some time regularly sent me parcels of material so obtained. Though only a small proportion of dredged material is obtained alive, on the whole it is in much better condition than that found on the beach. Even for shore species it has been found more profitable to dredge in very shallow water adjacent to the beaches and rocks than to rely on what is washed up by the tide.

The limitation of this paper to New South Wales is deliberate, as has been the determination to keep the limits of collecting within this area. The coast of New South Wales has long been considered a distinct zoogeographical province, separable on the one hand from the tropical waters of the Queensland coast, and on the other from the southern shores of Australia by the isthmus which until recently connected Tasmania with the mainland. With the east coast of Tasmania there is much closer relationship, and many zoologists have considered that these two areas should be merged into one province. A check of the species dealt with here rather strengthens this viewpoint. Hedley allowed 49 species under Rissoidae in his check list. This list is now raised to 95. Of these, 33 are described as new, but it is possible that the range of some of these will be later extended to Tasmania. Of the remainder, 36 species are so far found to be common to both areas, and these include many of the commonest and most typical forms.

Though a large number of new species and records is now added to the list, it is doubtful if this is yet nearly complete. The day of the systematist is not ended, for only when the lists are practically completed, and all the species identified and named, can the more important research be properly undertaken. Such questions, therefore, as comparative anatomy, life history, evolution and ecology are still largely problems for future study and solution.

ACKNOWLEDGEMENTS.

My thanks are particularly due to Miss Joyce Allan, Conchologist of the Australian Museum, who has read and checked the manuscript of this paper and has made many useful suggestions and corrections. To Mr. Tom Iredale, former Conchologist, I am also greatly indebted for advice and suggestions. Mr. Iredale's interest in the paper throughout its compilation has been particularly unselfish, inasmuch as he had years before actually completed a paper on the same subject, the manuscript of which was unfortunately lost. My son John has also contributed much, particularly in the collection and sorting of material, most of which we did together.

TYPES.

All specimens illustrated, in addition to the types of new species, have been presented to the Australian Museum.

FAMILIES AND GENERA.

Under Rissoidae is here included a rather heterogeneous assemblage of forms, between many of which there will probably ultimately be found but little relationship. For the purpose of a review of species, Hedley's New South Wales check list has been used as a basis, and all genera there included under Rissoidae have been dealt with. In a recent paper on the Australian Rissoidae, B. C. Cotton (1944, p. 286) has pointed out that *Rissoina*, *Rissolina* and *Stiva* are now recognized as belonging to a separate family, the Rissoinidae, while *Diala* goes to the Litiopidae and *Cithna* to the Cyclostremidae. Probably as knowledge grows a further regrouping of genera will be necessary.

Owing to the generally simple form of the shell, shell characters alone are sufficient for little more than specific determination, and questions of true genetic relationship are largely undecided. Even the selection of generic names for Australian rissoids is still a major problem. Certain groupings seem fairly natural, and as long as this is regarded as tentative and a matter of convenience no great harm is done. Throughout the world a multiplicity of genera have been introduced, but attempts to correlate

Australian species with these has led to much confusion. Iredale (1914) introduced a number of genera for Neo-Zealandic species, and both Hedley and May used Iredale's names for many New South Wales and Tasmanian shells. On the whole it seems wise to follow the same procedure, rather than plunge again into the maze of involved nomenclature in which so much of a research worker's time and energy is so hopelessly lost. It is a relief, in fact, to have on hand established generic names, and future writers can be left to thrash out their validity.

Unfortunately, Iredale, while he designated certain species as genotypes, and in a few cases discussed their relationship, entirely omitted any generic descriptions, and it has been left to others to define the limits his genera are intended to cover. That opinions have differed can be seen by comparing the check lists of New South Wales (Hedley) and Tasmania (May). In these each writer frequently uses different generic names for the same species, those under *Haurakia*, *Merelina* and *Estea* being particularly confused.

For this reason generic descriptions are here given, and may be considered as general interpretations adapted for the identification of Neo-Peronian forms alone. This had already been done before reading Cotton's paper, rather fortunately perhaps, as it ensured a quite independent approach to the problem. It is interesting, therefore, that the conclusions reached are almost identical, though differing in some details, mainly on the relative genetic importance of some shell characters. Cotton also gives a key to the various genera. While such keys are useful to students, they are of necessity somewhat artificial. I have not followed his key in this paper as, in my opinion, forms which seem closely allied are separated too widely—for instance, *Estea* and *Scrobs*. After checking this paper with Cotton's, some revision in names has been made, in order to bring the two as closely in line as possible. For instance, Cotton prefers *Scrobs* of Watson to Carpenter's genus *Amphithalamus*, which I think is justified, particularly as the genotype of *Scrobs* is a well-known Australian species. Of Cotton's new genera, *Subestea* and *Eusetia*, so far no New South Wales shells can be identified with them, and in turn I have added some new generic names for types unknown in South Australia. On the whole, however, I think the two papers dovetail well together and, it is hoped, will form a basis for future work on the group.

REVIEW OF SPECIES.

Reference.

"Hedley 535." Number in Hedley's Check List of Marine Mollusca of New South Wales. Supplement to Jour. Royal Society of N.S.W., Vol. li, 1917.

"May 476." Number in May's Check List of Mollusca of Tasmania. Govt. Printer, Hobart, 1921.

Genus **Rissoina** D'Orbigny.

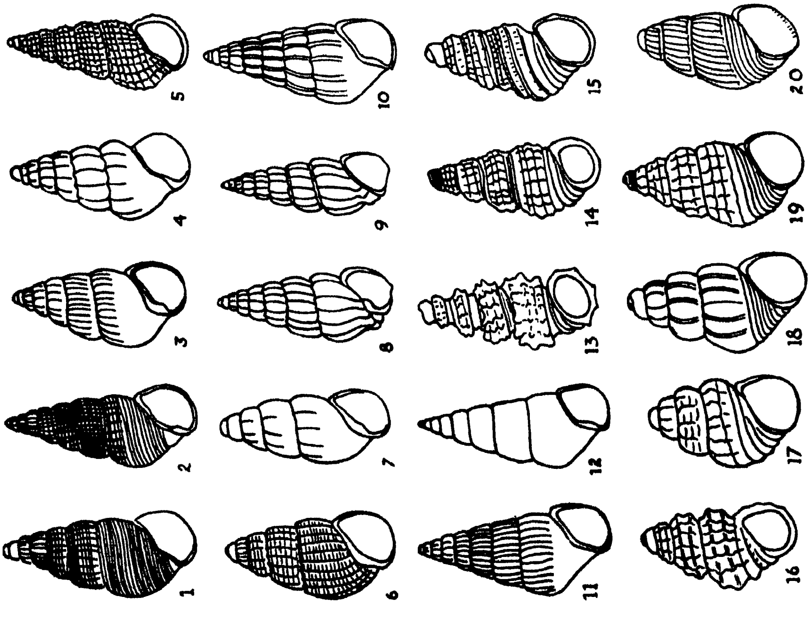
Under *Rissoina* are included elongated shells, of moderate size, from 3 to 7 mm. in length, solid, with entire, arcuate apertures. The peristome is thickened and is reflected back anteriorly to make a rounded, bay-like indentation on the inner margin. The sculpture may be spiral or transverse or both, and is sometimes cancellate.

Rissoina variegata Angas. (Fig. 1.)

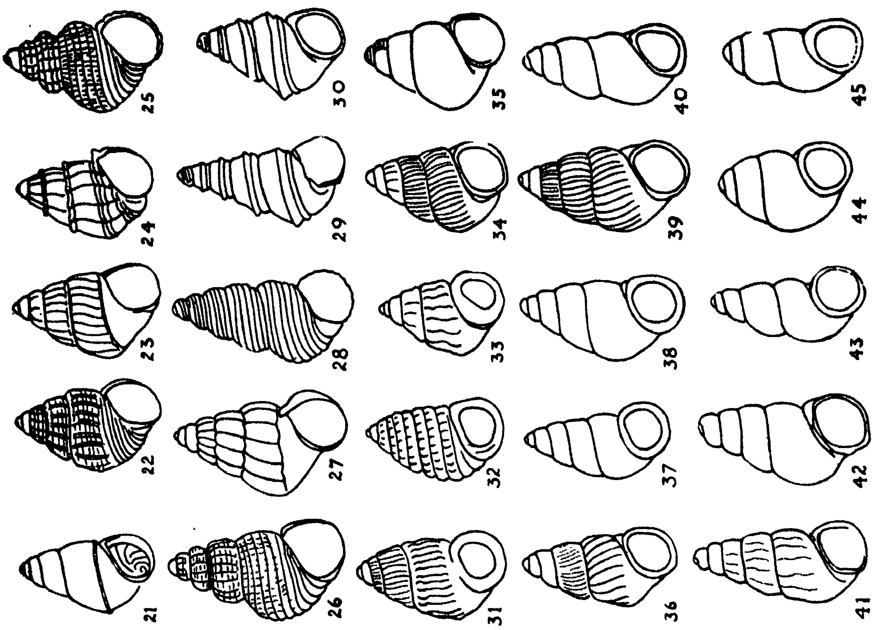
Hedley 536; May 480.

This is one of the commonest species on the coast. It is found in abundance under stones in rock pools between tide marks, both on the outer reefs and within the harbours. It is somewhat variable, chiefly in colour, but is generally marked more or less with brown. The ribs are also variable in strength, becoming less persistent on the later whorls, and are generally entirely absent on the body whorl of adult shells, the fine spiral striae alone being present.

The figured specimen is from Long Reef, its length 7 mm.



Figures 1-20.



Figures 21-45.

Rissoina elegantula Angas. (Fig. 2.)

Hedley 534; May 475.

This resembles *R. variegata* in general characters, but is slenderer, thinner, with very fine and delicate sculpture, and is white in colour. It is not a common shell and we have not taken it alive. It is generally found on the outer beaches. Length 7 mm.

Localities.—Point Halliday (figure); Long Reef; Shellharbour, etc.

Rissoina cretacea Ten.-Woods. (Fig. 3.)

Hedley 533.

Useful recognition marks are the glossy, white, vitreous texture, the faint transverse ribs and the absence of spiral sculpture. It is a deep-water species, and typical of the continental shelf. Length 6 mm.

Localities.—18 fathoms off North Head, Port Jackson (figure); 6–9 fathoms, Sow and Pigs Reef; 30–35 fathoms off Crookhaven. Hedley records it from 22 fathoms off the Manning River.

Rissoina fasciata Adams. (Fig. 4.)

Hedley 535; May 476.

This is another of the very common species on the coast. It has a lengthy synonymy, but Hedley's determination of the proper specific name is accepted. It is found with *R. variegata* alive under rocks in pools, but is very abundant on the beaches right throughout New South Wales. Though somewhat variable, this is more apparent than real, a sharply defined brown band below the suture often giving an angular appearance to the whorls. The broad, rounded ribs form a useful recognition mark.

The specimen figured was dredged in shallow water in North Harbour; length 5·8 mm.

Rissoina allanae, sp. nov. (Fig. 5.)

Shell elongated, conical, solid, pure white. Whorls 8, including protoconch, the first dome-shaped, the remainder rounded, sutures impressed. The first two whorls (protoconch) are smooth, the sculpture on the remainder consisting of well-defined sharp ribs, about 14 to a whorl, crossed at regular intervals by 4 to 5 sharp radial keels, elevated to points where they cross the transverse ribs, producing a regular, square cancellation, which persists right to the base. Aperture arcuate, angled posteriorly, expanded anteriorly, peristome complete, thickened, rounded on the outer margin, arched on inner margin. Length 5 mm.

Locality.—Woolgoolga, fairly common on the beach (type).

The regular and beautiful cancellation at once separates this from all other New South Wales species, but it would not be surprising to find its range extended north into

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Figures 1-20.

1, *Rissoina variegata* Angas. 2, *R. elegantula* Angas. 3, *R. cretacea* Ten.-Woods. 4, *R. fasciata* Adams. 5, *R. allanae* Laseron. 6, *R. iredalei* Laseron. 7, *R. usitata* Laseron. 8, *Rissolina crassa* Angas. 9, *Rissolina angasi* Pease. 10, *Stiva ferruginea* Hedley. 11, *S. royana* Iredale. 12, *S. nielseni* Laseron. 13, *Merelina cheilostoma* Ten.-Woods. 14, *M. gracilis* Angas. 15, *M. subreticulata* Laseron. 16, *M. eminens* Laseron. 17, *M. strangei* Brazier. 18, *M. ochroleuca* Brazier. 19, *M. apicilirata* Tate and May. 20, *Haurakia lucida* Laseron.

Figures 21-45.

21, *Microfossa incidata* Frauenfeld. 22, *Haurakia novarensis* Frauenfeld. 23, *H. descrepans* Tate and May. 24, *H. profundior* Hedley (after Hedley). 25, *H. filocincta* Hedley and Petterd (after Hedley). 26, *H. sculptilis* May. 27, *H. praeda* Hedley (after Hedley). 28, *Lironoba hebes* Laseron. 29, *L. imbrex* Hedley. 30, *L. praetornatilis* Hedley. 31, *Estea olivacea* Frauenfeld. 32, *E. castella* Laseron. 33, *E. salebrosa* Frauenfeld. 34, *E. jervisensis* Laseron. 35, *E. pyramidata* Hedley. 36, *E. frauenfeldi* Frauenfeld. 37, *E. tasmanica* Ten.-Woods. 38, *E. albisona* Laseron. 39, *E. narrabeenensis* Laseron. 40, *E. pulvilla* Hedley. 41, *E. figula* Laseron. 42, *E. perpolita* May. 43, *E. gemma* Laseron. 44, *E. gregaria* Laseron. 45, *E. alvea* Laseron.

Queensland. I have much pleasure in naming it after Miss Joyce Allan, Conchologist at the Australian Museum.

Rissoina iredalei, sp. nov. (Fig. 6.)

Shell broadly conical, slightly translucent, shining, yellowish, with tinges and patches of chestnut. Whorls 6, the first dome-shaped, smooth and white, the remainder increasing rapidly, slightly rounded, slightly angled below the sutures, which are deeply impressed. Aperture arcuate, slightly angled posteriorly, peristome complete, but reduced to a broad smear of callus on the body whorl, outer lip somewhat thin, inner lip arched and reflected anteriorly. Sculpture consisting of thin, sharp, well-defined, transverse ribs, about 16 on the body whorl. The spaces between the ribs are flat and crossed by numerous, regular, fine, spiral ridges. Length 5·5 mm.

Localities.—Dredged 15 fathoms between Heads, Port Jackson (type), 6 specimens; 14 fathoms off Long Reef, 2 specimens.

This handsome species is unlike any other Australian *Rissoina*; it is broader, has a thinner outer lip, and very distinctive sculpture. It is evidently an inhabitant of fairly deep water.

Rissoina usitata, sp. nov. (Fig. 7.)

Shell small, sub-cylindrical, thin, white, glossy and translucent except for a white, opaque band in the centre of each whorl. Whorls 5, the first broad and dome-shaped, the remainder slightly rounded, sutures indented. Aperture arcuate, peristome complete, but reduced on inner margin to a band of callus on the body whorl. The first whorl is smooth, the others have a few faint, incomplete, broad ribs, reaching from the suture to the centre; base smooth. Length 2·4 mm.

Locality.—15 fathoms off mouth of Clarence River (type), two specimens.

This is the smallest of the local species and is nearest to *R. cretacea*, than which it is smaller, narrower and thinner.

Rissoina lintea Hedley and May.

May 478.

This deep-water Tasmanian shell was recorded from 50–70 fathoms off Green Cape by T. Iredale (1924). It is generally like *R. variegata*, but is faintly striate, with a channelled suture.

Genus **Rissolina** Gould.

Rissolina is generally like *Rissoina*, but the inner margin of the peristome is reflected anteriorly to form a plate-like process over the columella. There is also a strong fold at the base of the whorl. The shell is heavy, the sculpture consisting of strong, well-defined, transverse ribs, persisting right to the base.

Rissolina crassa Angas. (Fig. 8.)

Hedley 538.

Rissolina angasi Pease. (Fig. 9.)

Hedley 537; May 481.

Hedley allowed both these species in his check list, and two species have been generally considered to occur on the coast. Both are common under rocks in pools, *crassa* being applied to larger, broader forms, *angasi* to smaller, narrower forms. Figure 8 is from a specimen in the Museum collected by J. Brazier from Little Coogee, 7 mm. long; figure 9 from a specimen from North Harbour, 6 mm. long. Specimens down to 4·5 mm. do not differ from the latter in any way.

Both species are allowed here, but it is by no means certain that they are distinct, as many intermediate forms seem to exist. Further study of long series of good material is necessary to decide this question.

Genus **Stiva** Hedley.

Stiva is like *Rissoina*, but with flatter whorls, and very large for the family, specimens being found up to 20 mm. in length. It has the same arcuate aperture, but Hedley (1904, p. 192) separated it chiefly by the operculum, which he describes as "peltate, concentric, . . . and with a horn resembling that of Jeffreysia". It is confined to deep water.

Stiva ferruginea Hedley. (Fig. 10.)

Hedley 540.

The specimen figured is from 50 fathoms off Sydney, and its length 19 mm. Hedley's type came from 100 fathoms, 16 miles east of Wollongong.

Stiva royana Iredale. (Fig. 11.)

Proc. Linn. Soc. N.S.W., xlix, 3, 1924, p. 245, pl. xxxiv, fig. 11.

Differs from *ferruginea* by being smaller and with more numerous and finer ribs. The type locality is from 10–25 fathoms, Twofold Bay, and the specimen here figured, 15 mm. long, is from the same locality. We also have it from 30–35 fathoms off Crookhaven.

Stiva nielseni, sp. nov. (Fig. 12.)

Shell conical, elongate, cream-coloured, faintly splashed with brown. Whorls 9, the first dome-shaped, white and glassy, the remainder nearly flat, increasing regularly, sutures distinct but not deeply impressed. Aperture arcuate, like a drawn bow, the outer margin expanded, the inner margin sharply arched. Peristome complete, thickened on the inner margin and reflected anteriorly. Nearly smooth except for faint growth-lines which are crossed by faint spiral striae. Length 13 mm.

Localities.—30–35 fathoms off Crookhaven (type); 18 fathoms off North Head, Port Jackson. A specimen was also picked up on Cronulla Beach.

Generally like *S. royana*, but can be readily distinguished by the absence of ribs, smaller size, and slightly narrower form. The species is named after Mr. T. Nielsen, skipper of the trawler "Joan" of Crookhaven, to whom I am indebted for much material from the continental shelf.

Genera **Merelina** Iredale and **Haurakia** Iredale.

Considerable confusion has occurred among Australian writers as to where the demarcation lies between these two genera. Iredale, when introducing the genera, gave no generic description, but observed in general discussion that *Merelina* has a spirally sculptured protoconch, is heavily varicosed, has a somewhat oval aperture, and varies from slender, elongate types to large, stout, tightly wound forms. The genotype is *Rissoa cheilostoma.* For *Haurakia* he gives no characters whatsoever. The genotype is *Rissoa hamiltoni*, a New Zealand species. In private conversation he has emphasized that the main difference between the two is that the protoconch of *Haurakia* is smooth, that of *Merelina* being spirally striated.

I have examined a number of specimens of *Merelina cheilostoma*, which is not uncommon, and, curiously enough, though it is the genotype of *Merelina*, with ordinary magnification the protoconch appears to be always quite smooth, while that of the closely related *M. gracilis* is strongly striate. On the general question of the value of the protoconch for genetic purposes I am inclined to agree with Dr. H. L. Kesteven, who states that there is a growing inclination to over-estimate its value (1905, p. 332). Another example will be referred to later in this section, where *Merelina ochroleuca* has a smooth protoconch, while the closely related *M. apicilirata* has a striated protoconch, yet these two species are, I should say, undoubtedly co-generic.

Both Hedley and May have had difficulty in assigning species to these two genera. For instance, Hedley places *novarensis* under *Merelina*, while May puts it under

Haurakia; on the other hand, *filocincta* is a *Haurakia* in Hedley's list and a *Merelina* in May's. A further complication arises by the use by Cotton of the genus *Linemara* of Finlay, the genotype of which is the New Zealand species *L. interrupta*. Of the New South Wales species, Cotton includes *filocincta* and *sculptilis* under *Linemara*. He remarks that it is distinguished from *Merelina* by a smooth, glossy and dome-shaped protoconch, and from *Haurakia* by the "tendency to a slight indentation and a stronger spiral rib near the suture". In view of what has already been said about the protoconch, this is not altogether satisfactory, and the latter character is altogether too slight for generic separation. The use of *Linemara* for Australian shells would therefore be better discontinued.

As a working basis and for the purpose of this paper, under *Merelina* are here classed heavy, elongate shells with thickened apertures and complete peristomes, while under *Haurakia* are broader, thinner shells, with the peristome interrupted, its inner margin reflected to produce an umbilical furrow or false umbilicus. Many of the species will be found to be between these two extremes, so that it is a matter of opinion under which they should be included; but the alternative would be to synonymize *Haurakia* under *Merelina* or to propose further new genera, a course I am reluctant to take without more data.

Merelina cheilostoma Ten.-Woods. (Fig. 13.)

Hedley 502; May 427.

This is a fairly common species on the outer beaches, and may be recognized by the extremely rugose sculpture and deeply indented sutures.

The specimen figured is from the Ocean Beach, Manly, its length 2·7 mm. We have also taken it from Port Stephens and from other beaches on the north and south coasts.

Merelina gracilis Angas. (Fig. 14.)

Hedley 503; May 429.

This species is found with the former on ocean beaches in many localities, and we have it from Port Stephens, Manly and Shellharbour. We have also taken it alive on seaweed at North Harbour within Port Jackson. The specimen figured is from this locality and is 2·6 mm. in length.

It is readily separated from *M. cheilostoma* by its less rugged sculpture and its strongly striated protoconch.

Merelina subreticulata, sp. nov. (Fig. 15.)

Shell conical, solid, yellow. Whorls 4½, including a 1½-whorled protoconch, which is globose and smooth. Whorls rounded, sutures deeply indented. Aperture ovate, not angled posteriorly. Peristome entire but reduced on the inner margin to a band of callus on the body whorl, where it is somewhat obscured by the overhang of the whorl. Outer lip rounded with a moderately thick varix. Sculpture on first mature whorl two keels, the upper the most prominent; on the next whorl three, and on the body whorl nine regular keels, more prominent above but persisting right to the base. The keels are overlaid by regular, transverse riblets, which rise to small protuberances where they cross the keels, but become obsolete on the lower part of the body whorl and the base. A slight umbilical furrow is caused by the reflection of the inner margin of the peristome anteriorly. Length 2·3 mm.

Localities.—6–9 fathoms, Sow and Pigs Reef (type); Ocean Beach, Manly.

This resembles *Rissoa apicilerata* Tate and May, a Tasmanian species, which has a less definite sculpture and a striated protoconch.

Merelina eminens, sp. nov. (Fig. 16.)

Shell small, colourless, translucent, solid, conical. Whorls 4½, including a 1½-whorled, smooth, globose protoconch. Later whorls rounded, sutures deeply impressed. Aperture ovate, slightly angled posteriorly. Peristome entire, outer margin with thick varix, inner margin rounded. Sculpture on first adult whorl a few indistinct ribs, on the second two prominent keels, and on the body whorl seven keels, regularly spaced and persisting to the base. These are crossed by well-defined, prominent, transverse ribs, which rise to sharp protuberances where they cross the keels, producing a regular cancellation. There are about 14 ribs to a whorl. Length of figured specimen 2·2 mm.

Habitat.—Probably a sand-living type. Fairly common on Ocean Beach, Manly (type); also in shell sand from Port Stephens.

The nearest ally to this is *M. hulliana* Tate, a common Tasmanian species.

Merelina strangei Brazier. (Fig. 17.)

Hedley 505.

This is a fairly common species, characterized by its small size, broad form and prominent, rounded ribs. We have found it alive and abundant under rocks at Long Reef, the length of the specimen illustrated being 2 mm. Also from shell sand at Port Stephens.

Merelina ochroleuca Brazier. (Fig. 18.)

Proc. Linn. Soc. N.S.W., xix, 1894, p. 174, pl. 14, f. 12 (not 11).

Hedley 501.

Hedley in his check list synonymized Brazier's species under *australiae* of Frauenfeld (1867). This is a curious and very unusual mistake by Hedley, for Frauenfeld's species, with its excellent description and illustration, is a totally different shell, which is discussed elsewhere in this paper with a new generic title. May further added to the confusion by identifying still another shell as *australiae*. The Tasmanian shell will probably need a new name, but that is outside the scope of this paper.

Brazier's description of *ochroleuca* is good; it is sufficient to add that it has a 1½-whorled protoconch which is smooth and white. The type locality is Watson's Bay, Port Jackson. The species is not unlike *strangei*, but is narrower, the widely separated ribs are not so prominent, and the base is regularly and finely striate.

Habitat.—It is not uncommon alive under rocks at Long Reef, the specimen figured is 2 mm. in length, and the colour of the live specimens is a pale yellow.

Merelina apicilirata Tate and May. (Fig. 19.)

Proc. Linn. Soc. N.S.W., xxvi, 1901, pl. 26, f. 61.

In the absence of Tasmanian shells for comparison, this has been rather doubtfully identified with Tate and May's species. It is thus either a new record for New South Wales or, if it finally proves different, a new species. It generally resembles *M. ochroleuca*, but is larger and has a strongly striated protoconch.

Habitat.—Alive on seaweed in rock pools, North Harbour, Port Jackson. Length of specimen figured 2·5 mm.

Haurakia lucida, sp. nov. (Fig. 20.)

Shell small, conical, colourless, translucent. Whorls 4, the first dome-shaped, remainder slightly rounded, sutures indented. Aperture ovate, slightly angled posteriorly, peristome interrupted, reflected and expanded anteriorly, moderately thick. The first whorl is smooth, on the second regular transverse ribs appear, of about equal width to the furrows. On the third whorl the ribs cease just above the suture, where they are replaced by two spiral rounded ridges of about the same magnitude. On the body whorl the ribs number about 22, ceasing about the centre, being replaced on the lower half by regular spiral ridges which persist right to the base and continue inside the aperture. Length 2·2 mm.

Habitat.—Unknown, but probably living in sand in shallow water. Three specimens, including the type, were found in shell sand, Ocean Beach, Manly; two specimens from Shellharbour.

The interrupted peristome places this in *Haurakia*, from the other species of which it differs by its narrower form and distinctive sculpture.

Haurakia novarensis Frauenfeld. (Fig. 22.)

Hedley 504; May 412.

This handsome species is not uncommon on the outer beaches, and we have found it at Port Stephens, Manly Beach, Kurnell and Shellharbour. We have also dredged it in five fathoms in North Harbour, and procured one specimen alive on seaweed from four fathoms off Woollahra Point, Port Jackson. Length of specimen figured (Shellharbour), 2·5 mm. Hedley placed this species under *Merelina*, but on the limitations of generic characters here adopted it is a typical *Haurakia*, under which genus May included it in his check list. It is not unlike *H. strangei* in general characters, but is larger and has finer and more defined sculpture.

Haurakia descrepans Tate and May. (Fig. 23.)

Hedley 498; May 411.

Hedley (1908, p. 468) described this as a new species, *Rissoa incompleta*, but afterwards synonymized it with Tate and May's species. We have it from shell sand, Port Stephens, but it is not a common shell. The specimen figured is 2·5 mm. long. A ready recognition mark is the absence of sculpture on the base, and the wavy, spiral ridge cutting off the radial ridges on the body whorl.

Haurakia profundior Hedley. (Fig. 24, after Hedley.)

Hedley 499.

This is a deep-water species, the type locality 800 fathoms, 35 miles east of Sydney. Only deep-sea expeditions are likely to procure further specimens.

Haurakia filocincta Hedley and Petterd. (Fig. 25, after Hedley.)

Hedley 500; May 428.

This is another deep-water species, the type locality from 250–300 fathoms off Sydney. We have not yet taken it, though like some other species it may occur higher up on the continental shelf.

Haurakia sculptilis May. (Fig. 26, after Hedley.)

May 431.

Like *filocincta*, but with an extra whorl, rather narrower and with finer sculpture. Taken from 30–35 fathoms off Crookhaven (a new record for the State). Length 3 mm.

Haurakia praeda Hedley. (Fig. 27, after Hedley.)

Hedley 516.

Hedley included this under *Estea*, but from his figure and description it is a typical *Haurakia*. The type came from Middle Harbour, but we have not yet collected this species. It has the same abruptly terminated, transverse ridges as *H. descrepans*, but they are fewer and wider.

Genus **Lironoba** Iredale.

Iredale (1914) gives no generic characters at all for *Lironoba*, beyond that *Rissoa suteri*, a New Zealand species, is the genotype. For the purpose of this paper we are taking *Lironoba imbrex* Hedley as typical of the New South Wales species. *Lironoba* will therefore include solid, elongate shells, of moderate size, imperforate, with oval or ovate apertures, the peristome complete, but its inner margin sometimes obscured by the overhang of the body whorl. The sculpture, as distinct from *Merelina*, is spiral only, and consists of prominent keels, varying from two or three to many. As with *Merelina* and *Haurakia*, the protoconch may be strongly lirate or smooth. In *L. imbrex* it is not only lirate, but is separated from the adult whorls by a distinct varix. *Lironoba* is essentially a deep-water genus. Only three species have so far been recorded off our coast but, as many more are found in Tasmania, it is to be expected that some of these or new species will yet be found on the continental shelf.

Lironoba imbrex Hedley. (Fig. 29.)

Hedley 507.

Readily recognized by its elongate form, strong double keel and striate protoconch, separated from the adult whorls by a strong varix. Type locality, Middle Harbour. We have dredged it from North Harbour, the figured specimen being 5 mm. long. We also have it from 6–9 fathoms, Sow and Pigs Reef, 15 fathoms between Port Jackson Heads, and from 30–35 fathoms off Crookhaven.

Lironoba praetornatilis Hedley. (Fig. 30.)

Hedley 508.

Like *imbrex*, but smaller, shorter and broader, the protoconch less strongly lirate with no varix. Type locality 35 fathoms off Broughton Island. We have it from 14 fathoms off Long Reef, the figured specimen 3 mm. in length, and from 30–35 fathoms off Crookhaven.

Lironoba hebes, sp. nov. (Fig. 28.)

Hedley 505, *Lironoba agnewi* Ten.-Woods.

Shell of moderate size, thinner than other members of the genus, pale yellow, conical. Whorls 5½, the first somewhat inflated, rounded, increasing regularly, sutures deeply impressed. Aperture rounded, peristome entire, somewhat thin, standing vertically on the inner margin producing a false umbilicus, expanded slightly anteriorly. Sculpture on the initial whorl obscure striae; on the second whorl four, on the third and fourth whorls five, and on the body whorl about 10 spiral, rounded keels, equally spaced and separated by narrower smooth furrows. The spiral sculpture persists right to the base. Length 4·5 mm.

Habitat.—Deeper water. Taken from 14 fathoms off Long Reef (type); 8–10 fathoms off Point Halliday; 15 fathoms between Heads, Port Jackson; 30–35 fathoms off Crookhaven.

This is No. 505, *Lironoba agnewi* Ten.-Woods., of Hedley's check list. He (1904, p. 184) records it from 100 fathoms off Wollongong. Hedley himself had doubts about the identification of this Tasmanian species, and submitted specimens to May, who, identifying it with *L. agnewi*, remarked that it had an extra whorl and blunter apex. These characters are constant in all our specimens, and as experience in this section of the Rissoidae shows that there is practically no variation of this nature in the various species, it must be removed from *L. agnewi* and given specific status.

Genus **Microfossa**, gen. nov.

Genotype, *Subanaea incidata* Frauenfeld.

Shell minute, brown, solid, conical, few-whorled, imperforate. Aperture sub-ovate, angled posteriorly, peristome entire, outer margin reflected, whorls slightly flattened, angled at the periphery, on which is a narrow but sharply defined channel. Operculum thick and horny and, as far as can be determined, spiral, the spirals few and rapidly expanding and crossed by wavy growth lines, the nucleus sub-marginal.

Allied to *Estea* and *Scrobs*, but differs from both by the shape of the aperture and by the distinct channel on the periphery of the body whorl.

Microfossa incidata Frauenfeld. (Fig. 21.)

Hedley 514.

This is a common weed-living species right along the coast, and we have found it alive on various species of algae in rock pools at Ballina, Yamba, Point Halliday, Long Reef, North Harbour and Huskisson; also in beds of the common mussel at Bottle and Glass Rocks, Port Jackson. The specimen figured is from Long Reef, 1·5 mm. in length.

Though included in *Estea* by Hedley, its distinctive shell characters are anomalous in an otherwise fairly uniform group, necessitating its generic separation. It is also recorded from Tasmania, May No. 445, but from the figure this is definitely not Frauenfeld's species and needs revision.

Genus **Estea** Iredale.

Once again Iredale gives no generic description, but mentions the following characters in discussion: "Aperture perpendicular, circular, peristome reflected all round." These characters fit very well the group of species included by both Hedley and May in their check lists. It might be added that they are all small to minute, solid, few-whorled, the sculpture varying from more or less irregular ribs to growth lines; or they may be quite smooth. Most of the species are brown, but there are some white or colourless shells of rather a different facies, whose relationship may be more apparent than real.

In May's check list one group of these is separated from *Estea* under *Dardanula* Iredale, the genotype of which is a New Zealand species, *Dardanula olivacea* Hutton (not *olivacea* Frauenfeld). Iredale gives no description, but Cotton (1944) gives details of both the shell and operculum, the salient points of which are smooth, flattened whorls and a sub-spiral, ovate operculum, with a long shelly process below the nucleus. The only New South Wales species he lists as *Dardanula* is *flammea*. I have so far been unable to extract and examine the operculum of *flammea*, and it is retained for the time being in *Estea*, but further information will probably justify not only its separation but also that of several closely allied species.

Estea olivacea Frauenfeld. (Fig. 31.)

Hedley 515; May 452.

This is identified from the original description, though our specimens are typically somewhat broader. The colour is pale to deep yellow-brown, and the sculpture is variable, the earlier whorls being quite smooth, with ribs developing only on the last two whorls, though these may also occasionally be nearly smooth.

It is one of our common species. We found it abundant, alive, under stones in North Harbour, the specimen figured 2 mm. in length; also at Huskisson and on the reclamations, Bay View, Pittwater.

Estea castella, sp. nov. (Fig. 32.)

Shell small, solid, conical, yellow. Whorls 4½, the first 1½ small and rounded, then rapidly expanding, somewhat flattened, sutures narrowly channelled. Aperture nearly circular, peristome entire and reflected all round. The first 1½ whorls are smooth, the first adult whorl with indistinct ribs, the penultimate and body whorls with three spiral, broad, rounded folds. These are crossed by regular, transverse ribs, which become obsolete as they cross the furrows, but are elevated into nodules on the folds, giving the whole a strongly granulated appearance. The base, except for one slight fold is smooth. Length 1·8 mm.

Habitat.—Deeper water. 30–35 fathoms off Crookhaven (type), 1 specimen; 6–9 fathoms, Sow and Pigs Reef, 4 specimens.

The spiral sculpture separates this from all other Australian Esteas, but in its absence it would not be unlike *E. olivacea.*

Estea salebrosa Frauenfeld. (Fig. 33.)

Hedley 519.

This can be identified very well from the original description and also from shells so labelled in the Australian Museum. The broad pyramidal shape and the few coarse ribs somewhat indented in the centre are good recognition marks. We have not taken this species alive. The specimen figured, length 2·2 mm., is from the reclamations, Bay View, Pittwater, and we also have it from 6–9 fathoms, Sow and Pigs Reef. The type locality is Sydney.

Estea jervisensis, sp. nov. (Fig. 34.)

Shell large for the genus, solid, broadly conical, brown, generally with a white band of varying width on the centre or base of the body whorl. Whorls 5, increasing evenly, slightly rounded, sutures impressed, generally marked by a white line. Aperture nearly round, peristome entire, reflected all round, but slightly more at the inner margin, where it is flattened and fused to the body whorl. The first two whorls are smooth, the remainder have numerous rounded, slightly oblique, transverse ribs, becoming obsolete on the base. Length 3·7 mm., width 2 mm.

Locality.—Abundant on the beach at Huskisson, Jervis Bay.

This is one of a group of species which centre round *E. olivacea* and *E. frauenfeldi*. The described differences are not great, but are very constant, and the species can be easily separated on comparison. *E. jervisensis* differs from *E. olivacea* by being nearly twice the size, broader, and with more numerous ribs. The same differences separate it from *E. frauenfeldi*. It also resembles *E. kershawi* Ten.-Woods, a Tasmanian species.

Estea pyramidata Hedley. (Fig. 35.)

Hedley 518.

This is a deep-water species characteristic of and abundant on the continental shelf. The type came from 54–59 fathoms off Wati Mooli, and Hedley records it from other localities. We have it from 30–35 fathoms off Crookhaven, the figured specimen 2·2 mm. long; 20 fathoms Shoalhaven Bight (mud); 60 fathoms off Botany; and 40 fathoms Twofold Bay.

The broad, pyramidal shape and peculiar striate protoconch are easy recognition marks. In his original description Hedley placed it under *Scrobs*, but in his check list removed it to ***Estea***. Cotton returned it to *Scrobs*, but actually it fits neither genus, and ultimately I think will need a new generic name altogether.

Estea frauenfeldi Frauenfeld. (Fig. 36.)

Hedley 513.

The type locality is given as from the upper end of Sydney Harbour. It can be separated from *E. olivacea* by its larger size; it is slenderer, with a sub-sutural white band, and has fewer and more irregular ribs. These are often obsolete on all but the body whorl.

Habitat.—Alive under stones, North Harbour, the figured specimen 2·5 mm. long.

Estea tasmanica Ten.-Woods. (Fig. 37.)

May 457.

This is an addition to the New South Wales fauna. It may be considered the deep-water representative of *E. frauenfeldi*, but is slenderer, slightly larger, and of a chestnut colour rather than chocolate. The ribs, too, are practically obsolete and are replaced by fine growth lines—May says "faintly striate". We have it abundantly from 30–35 fathoms off Crookhaven, the figured specimen 2·8 mm.; also from 14 fathoms off Long Reef.

Estea albizona, sp. nov. (Fig. 38.)

Shell of medium size for the genus, solid, conical, somewhat tumid, brown to chestnut, with a well-marked, sharply defined, white, sub-sutural band. Whorls five, the first dome-shaped, the remainder slightly rounded, sutures hardly at all indented. Aperture rounded, evenly reflected all round. Practically smooth, the only sculpture faint, irregular, oblique growth lines, a few irregular transverse ribs sometimes present on the body whorl. Length 2·8 mm.

Habitat.—Found alive fairly abundantly on seaweed in rock pools at Point Halliday (type).

This is another of the *frauenfeldi* group and at first was considered but a variety of that species. In view of the constancy in shape and size of the Esteas, however, it has been separated as a distinct species. Its tumid shape, general smoothness and the unindented suture are good recognition points, also the sub-sutural white band is very distinct and sharply defined.

Estea narrabeenensis, sp. nov. (Fig. 39.)

Shell large for the genus, solid, conical, colour brown, slightly variegated with white. Whorls 5½, the first half-whorl flat, the next dome-shaped, remainder slightly rounded, sutures slightly indented. Aperture nearly circular, peristome entire, reflected all round, slightly flattened on the inner margin. The first 1½ whorls are smooth, the remainder are crossed by regular, rounded, somewhat oblique ribs, about 20 to the whorl, becoming obsolete on the base. Length 3·5 mm.

Habitat.—Alive on seaweed in rock pools, Long Reef (type).

This is another of the *frauenfeldi* group and is close to *E. jervisensis*, from which it differs by its narrow form and in the details of the sculpture. Both these species are larger than any of the other related species, each being 3·5 mm. or more in length.

Estea pulvilla Hedley. (Fig. 40.)

Hedley 517.

Agreeing very well with Hedley's description and figure, this species has been identified from the type locality, Manly Beach, from where the figured specimen is 2·5 mm. in length. We also have it from shell sand, Port Stephens, and from 15 fathoms off the Clarence River. It is to be noted that the two brown bands mentioned by Hedley are not always present, and most of the specimens collected, as well as those labelled *pulvilla* in the Australian Museum, are pure white.

Estea figula, sp. nov. (Fig. 41.)

Shell of medium size for the genus, solid, conical, elongate, white to pale yellow, shiny with a translucent sub-sutural band. Whorls 5½, initially rather globose, the remainder slightly rounded, sutures moderately indented. Aperture sub-circular, peristome entire, slightly reflected on outer margin, but widely reflected on inner anterior margin and narrowed and straightened where fused onto the body-whorl. Sculpture smooth except for a few faint growth lines, the surface porcellaneous and shining. Length 2·6 mm.

Localities.—A number of specimens, including type, were picked out from unsorted material collected by Mr. Roy Bell from 15–25 fathoms, Twofold Bay.

This was at first thought to be *E. obeliscus* May, but that species has two more whorls and a more tumid protoconch.

Estea perpolita May. (Fig. 42.)

May 453.

One specimen, 1·8 mm. in length, was picked out from unsorted material collected by Mr. Roy Bell from 40–50 fathoms, Twofold Bay. The main characteristics are the tumid protoconch and highly porcellaneous surface. This is a new record for the State, but must be considered tentative, as more material may show that it is a new species. True *perpolata* has a more flattened protoconch than the one here recorded.

Estea gemma, sp. nov. (Fig. 43.)

Shell minute, cylindrical, elongate, deep chocolate, with a resplendent, highly polished surface. Whorls 5, the first flattened and small, the second rapidly increasing, the remainder rounded, sutures moderately impressed. Aperture round, expanded, peristome entire, greatly reflected anteriorly. There is no sculpture, the surface being quite smooth and very highly polished. Length 1·5 mm.

Habitat.—Alive on seaweed in channels exposed to the inrush of the surf. Abundant at Crookhaven Heads (type); Brunswick Heads; Shellharbour. Specimens have been found on beaches in intermediate localities, but dead specimens are paler and much less resplendent.

This beautiful little species is quite unlike others of this genus. It can be readily distinguished by its slender form, expanded aperture, and the brilliance of its lustre.

Estea gregaria, sp. nov. (Fig. 44.)

Shell minute, the smallest of the genus, short and broad, fairly solid, uniformly deep brown. Whorls 4, the first small and dome-shaped, the remainder rapidly increasing, rounded, sutures hardly indented, body whorl inflated. Aperture round, peristome entire, evenly reflected all round. Sculpture almost absent, consisting of a few faint growth lines, the surface otherwise smooth, slightly shining, and in living specimens slightly translucent. Length 0·8 to 0·9 mm.

Habitat.—Abundant, living in many locations; under stones in rock pools, North Harbour (type), and at Long Reef; on seaweed at North Harbour and Point Halliday, and in mussel beds at Bottle and Glass Rocks. Also dredged from 6–9 fathoms off Sow and Pigs Reef.

This is a well-defined and constant little species, not easily confused with any other *Estea*. It is readily distinguished by its minute size and by its inflated and broadly oval silhouette.

Estea alvea, sp. nov. (Fig. 45.)

Shell minute, solid, cylindrical, yellow. Whorls 4, the first flattened and small, the next much larger, and the penultimate and body whorl nearly the same size, giving the whole shell a characteristic contour. Aperture sub-circular and expanded, peristome entire, evenly reflected all round. There is no sculpture and the shell surface is slightly lustrous. Length 0·9 mm.

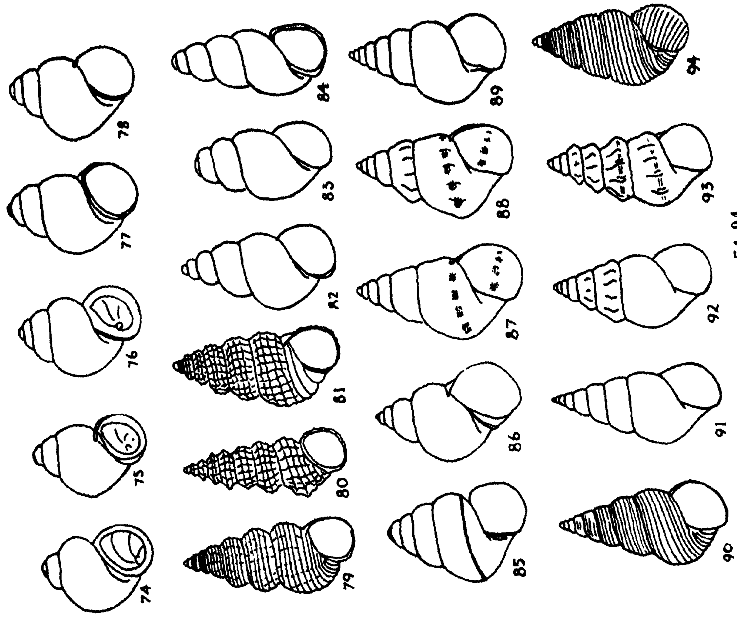
Locality.—6–9 fathoms, Sow and Pigs Reef (type), two specimens; also from dredgings in North Harbour.

Again the minute size is a distinguishing character, as is also the curious beehive-like contour. Though only a few specimens have been noted to date, it is probably not as rare as it seems. It is inconspicuous and can readily be overlooked.

Estea bicolor Petterd. (Fig. 46.)

Hedley 511; May 441.

The largest of the genus, can be readily recognized by the sub-sutural, white band, flattened whorls, long spire (6½ whorls), and ovate mouth. A deep-water species, we have dredged it in 15 fathoms between the Heads, Port Jackson, on a sandy bottom; the figured specimen from this locality 5 mm. in length. We also have it from 30–35 fathoms off Crookhaven, and it is not uncommon in other localities on the continental shelf.



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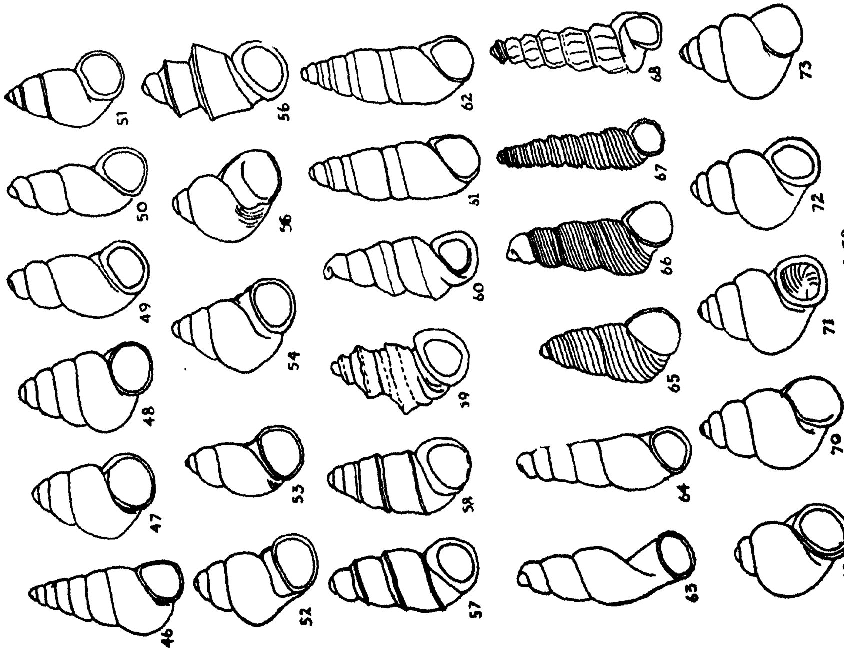

Figures 46-73.

Estea flammea Frauenfeld. (Fig. 47.)

Hedley 512; May 438.

The type locality is Botany Bay, but it is abundant right down the coast, living on seaweed in the rock pools. Alive it is a bright red colour, but partly faded dead specimens are variegated with white. The figured specimen, 2·2 mm. long, is from seaweed at Point Halliday, and other specimens come from North Harbour, Jervis Bay, etc.

May included this under *Dardanula* Iredale. As Iredale gives no generic characters at all for *Dardanula*, I can offer no opinion on its validity, but am following Hedley in its allocation to *Estea*.

Estea erratica May. (Fig. 48.)

May 437.

This is a new record for New South Wales. Specimens were found in shell sand, Ocean Beach, Manly, the figured specimen 1·8 mm. long. The species is like *flammea*, but white, the whorls more compressed, and there is an extra whorl, making 5 in the same length. May includes this under *Dardanula*, and it is certainly co-generic with *flammea*, and these two species, whatever genus they are discussed under, must be kept together.

Genus **Scrobs** Watson.

Under *Scrobs* are included Australian shells which have the same general character as *Estea*, but differ in the details of the aperture. The peristome is entire as in *Estea*, but owing to a tendency of the shell to become uncoiled there is a channel between it and the body whorl. The inner margin of the aperture is also generally flat. The width and shape of the channel are a good guide for specific determination. It may be reduced to a narrow slit, it may be widened at either end, or it may be broad and pit-like with ridges at either end connecting the peristome to the body whorl. In extreme cases the peristome may disappear on the inner margin and be replaced by a shelf within the aperture. The curious little shell called *Epigrus protractus* by Hedley, which is later discussed under the new generic name *Saltatrix*, shows certain affinities with *Scrobs* and may possibly represent the ultimate development of this type of aperture.

Scrobs scrobiculator Watson. (Fig. 49.)

Hedley 528.

This is the genotype of *Scrobs* and excellently represents the main characters of the genus. The channel flanking the aperture is narrow but deep, and widens slightly

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Figures 46-73.

46, *Estea bicolor* Petterd. 47, *E. flammea* Frauenfeld. 48, *E. erratica* May. 49, *Scrobs scrobiculator* Watson. 50, *S. petterdi* Brazier. 51, *S. vincula* Laseron. 52, *S. jacksoni* Brazier. 53, *S. delta* Laseron. 54, *S. pyramis* Laseron. 55, *S. pluteus* Laseron. 56, *Anabathron contabulatum* Frauenfeld. 57, *A. lene* Hedley. 58, *A. nothus* Laseron. 59, *A. emblematicum* Hedley. 60, *A. semicinctus* May. 61, *Epigrus dissimilis* Watson. 62, *E. cylindricus* Ten.-Woods. 63, *Saltatrix protractus* Hedley. 64, *Epigrus badius* Petterd. 65, *Microdryas australiae* Frauenfeld. 66, *M. elongata* Laseron. 67, *Attenuata integella* Hedley. 68, *Coenaculum minutula* Tate and May. 69, *Notosetia fulva* Laseron. 70, *N. procincta* Hedley. 71, *N. nitens* Frauenfeld. 72, *N. pellucida* Laseron. 73, *N. simillima* May.

Figures 74-94.

74, *Notosetia fusca* Laseron. 75, *N. aethiopia* Laseron. 76, *N. galbinia* Laseron. 77, *N. atropurpurea* Frauenfeld. 78, *N. castanea* Laseron. 79, *Obtortio lutosus* Hedley. 80, *O. jacksonensis* Laseron. 81, *O. reticulata* Laseron. 82, *Rissopsis puniceus* Laseron. 83, *R. brevis* May. 84, *Paranoba subquadrata* Laseron. 85, *Cithna angulata* Hedley. 86, *Laevilitorina mariae* Ten.-Woods. 87, *Diala phasianella* Angas. 88, *D. phasianella* Angas (*monile* variation). 89, *D. translucida* Hedley. 90, *D. lirata* Laseron. 91, *D. lauta* Adams. 92, *D. lauta* Adams (*monile* variation). 93, *D. lauta* Adams (*monile* variation). 94, *Laevitesta scobina* Laseron.

at the posterior end. We have not taken it alive but, like other species of the group, it probably lives on seaweed. The colour of the dead specimens is brownish-yellow. It is abundant on the reclamations at Bay View, Pittwater, the figured specimen 1·8 mm. in length; and also from dredgings from 6–9 fathoms, Sow and Pigs Reef.

Scrobs petterdi Brazier. (Fig. 50.)

Hedley 527; May 468.

Like *S. scrobiculator*, but smaller, narrower, and the channel reduced to a thin, straight crack. Alive on seaweed in the rock pools at North Harbour, the figured specimen 1·2 mm. in length; also under rocks in the same locality; and on seaweed, Crookhaven Heads. Colour of living specimens, deep brown-red.

Scrobs vincula, sp. nov. (Fig. 51.)

Shell minute, solid, conical, deep brown-red. Whorls 4½, the first 1½ dome-shaped, remainder increasing regularly, rather flattened. Aperture sub-circular, expanded, slightly angled posteriorly. Peristome entire, reflected all round, flattened transversely on inner margin, the channel reduced to a mere line. There is no sculpture, except a slight, rounded keel immediately above the sutures, which are barely indented. Length 1·6 mm.

Habitat.—Alive on seaweed, rock pools, North Harbour (type).

This is rather doubtfully referred to *Scrobs*. The flattened inner margin of the peristome keeps it in *Scrobs*, but the channel is practically non-existent, which suggests *Estea*. The narrow keel just above the suture again suggests *Anabathron*, and it is possible that relationship lies somewhere between the three genera.

Scrobs jacksoni Brazier. (Fig. 52.)

Hedley 526; May 466.

We have not taken this alive, but it is abundant in dredgings, 6–9 fathoms, Sow and Pigs Reef, the figured specimen 1·7 mm. in length. It is also abundant on the Ocean Beach, Manly. The colour of dead specimens is amber. It can be recognized by the broad, trough-shaped channel, which is enclosed by ridges both anteriorly and posteriorly connecting the peristome to the body whorl.

Scrobs delta, sp. nov. (Fig. 53.)

Shell minute, solid, conical, red-brown, shining. Whorls 4, the first small, then increasing rapidly, the body whorl elongated, slightly rounded, the sutures moderately impressed. Aperture semi-circular, peristome complete, reflected and expanded on outer margin, the inner margin slightly curved. The channel is well marked and trough-like, as in *S. jacksoni*, but is narrow anteriorly and widened greatly at its posterior end, where it is enclosed by a ridge connecting the peristome to the body whorl. The only sculpture consists of a few faint spiral lines right at the base. The surface of the shell is polished and shiny. Length 1·2 mm.

Habitat.—Alive under stones in rock pools, Long Reef (type); also under stones and on seaweed, North Harbour; and in mussel beds, Bottle and Glass Rocks.

It is closely related to *S. jacksoni*, from which it is readily separated by the delta-shaped channel, smaller size and much narrower form.

Scrobs pyramis, sp. nov. (Fig. 54.)

Shell comparatively large for the genus, pyramidal in contour, solid, pale yellow to amber in dead specimens. Whorls five, the first very small, increasing regularly, flattened, sutures barely indented. Aperture semi-circular, peristome complete, slightly curved on inner margin. Channel wide and trough-like, slightly broader at posterior end, where it is enclosed by a ridge connecting the peristome to the body whorl. There is no sculpture and the surface is smooth and shining. Length 2 mm.

Locality.—We have not found this alive, but it is not uncommon on the Ocean Beach, Manly (type).

This is also related to both *S. delta* and *S. jacksoni*, from both of which it can be readily distinguished by its pyramidal form and in the details of the aperture.

Scrobs pluteus, sp. nov. (Fig. 55.)

Shell minute, solid, broadly conical, reddish-brown, base white. Whorls three, the first dome-shaped, others rounded, body whorl inflated, sutures indented. Aperture greatly expanded, outer margin rounded and reflected, peristome obsolete on inner margin, being replaced by a broad, flat shelf, with a thin, curved edge, well within the aperture. This shelf is enclosed on either side by ridges joining the peristome to the body whorl. Sculpture absent, except for a few well-marked radial striae right on the base. The smallest of the group, length 1 mm.

Locality.—6–9 fathoms, Sow and Pigs Reef (type), three specimens.

This extraordinary little shell is quite unlike any other Australian rissoid and can be readily recognized by the peculiar structure of the aperture. This almost justifies generic separation, but I think it may well represent an extreme phase in the development of the typical *Scrobs* channel. If, for example, the inner portion of the peristome of *S. jacksoni* became obsolete, the bottom of the channel would remain as a shelf within the aperture, similar to this species. It is thus retained in *Scrobs*, the other species of which it closely resembles in general facies.

Genus **Anabathron** Frauenfeld.

The genotype is *A. contabulatum*. The group seems a natural one and includes small, solid shells, imperforate, with rounded apertures, the peristome complete and either thickened or reflected, thus recalling *Estea*, from which it differs by the possession of one or more prominent spiral keels, giving a marked angularity to the whorls.

Anabathron contabulatum Frauenfeld. (Fig. 56.)

Hedley 520; May 461.

This species is easily recognized by the extreme angularity of the whorls. The colour is very deep, a reddish-brown, almost black at times in living specimens. We have found it alive on seaweed in rock pools at Shellharbour, the figured specimen 1·2 mm. in length; also on seaweed at North Harbour; and in shell sand on the ocean beaches right along the coast.

Anabathron lene Hedley. (Fig. 57.)

Hedley 520A; May 461.

Frauenfeld (1867) originally figured this species as a variety of *A. contabulatum*, and Hedley gave it the varietal name of *lene* in his check list, May following the same procedure in the Tasmanian list. Having collected it alive in quantity from numerous localities, and after repeated comparisons of large series, there can be no doubt that it is a distinct and constant species and that there is no gradation between it and *contabulatum*. The much less angularity of whorls is the chief difference, but the apex is more inflated and generally it is a narrower shell. The colour also differs constantly; it is bright red, much lighter than *contabulatum*, and when together they can be readily sorted by this means alone. It is more abundant than *contabulatum*, and we have found it alive under stones at Long Reef, the figured specimen 1·3 mm. in length; also on seaweed in rock pools at North Harbour and Shellharbour; and at other localities right along the coast.

Anabathron nothus, sp. nov. (Fig. 58.)

Shell comparatively large, solid, conical, deep brown. Whorls five, the first rounded, increasing regularly, flattened, sutures moderately impressed. Aperture sub-circular, expanded, peristome entire, reflected all round, slightly flattened on inner margin. The sculpture consists of two widely separate keels, the uppermost just below the suture, not prominent and little more than a rounded swelling, the lower narrower, rounded and higher, making it more conspicuous and giving a slight angularity to the body whorl. The whorls are crossed by faint, rather irregular and oblique growth lines. Length 2 mm.

Habitat.—Alive on seaweed, Point Halliday, one specimen (type); and under stones, North Harbour, two specimens.

This is placed with some doubt under *Anabathron.* In one way or another it combines the characters of several genera, *Anabathron*, *Estea* and *Scrobs.* It is very close in many ways to *Scrobs vincula*, than which it is larger and with well-defined keeling. Both species are on the borderline, probably closely related, but the one verges towards *Anabathron*, the other towards *Scrobs.*

Anabathron emblematicum Hedley. (Fig. 59.)

Hedley 521.

This species is not unlike *contabulatum*, but the prominent keel is medially placed and is crossed by irregular, transverse ribs, which may become obsolete, except where they cross the keel, where they appear as irregular undulations. We have not found this species alive, but it is not uncommon on the ocean beaches at Port Stephens, the figured specimen 2 mm. in length; and on the Ocean Beach at Manly. The colour of the dead specimens is yellow.

Anabathron semicinctus May. (Fig. 60.)

May 465.

This is a new record for the State. Two specimens were sorted from mud from 30–35 fathoms off Crookhaven, the one figured 1·8 mm. in length. May described this species as an *Epigrus*, but the characters of the aperture and the keeling preclude this and bring it within the suggested limits of *Anabathron.* The curious tilted protoconch is a distinguishing feature, and probably it would be better placed in a new genus, though I think further knowledge is desirable before this step is taken.

Genus **Epigrus** Hedley.

Hedley's original description reads: "Shell tall, slender, smooth, cylindrical. Aperture oblique, appressed; apex large, often protuberant." To this might be added that the genotype is colourless and translucent. It is probable that the question of shell texture in shells of simple type will ultimately be found to be of considerable generic importance.

Epigrus cylindricus Ten.-Woods. (Fig. 62.)

Hedley 523; May 463.

This is a deep-water species and we have it fairly abundantly from 18 fathoms off North Head, Port Jackson, the figured specimen 5 mm. in length; from 14 fathoms off Long Reef; and from 15 fathoms off the Clarence River.

Epigrus dissimilis Watson. (Fig. 61.)

Hedley 524; May 464.

This very closely resembles *E. cylindricus*, but is little more than half the size, the figured specimen from 6–9 fathoms off Sow and Pigs Reef being 3 mm. in length; there are only four whorls as against five in *cylindricus*, and the inner margin of the aperture is slightly more transverse. We have it also from 15 fathoms off the Clarence River.

Epigrus badius Petterd. (Fig. 64.)

Hedley 522; May 462.

Though Hedley included this species in *Epigrus*, it has many points in common with *Scrobs*, also with the curious *Epigrus protractus*, which is now separated under the new generic name *Saltatrix*. It is a small shell, the figured specimen from 6–9 fathoms, Sow and Pigs Reef, 2·2 mm. in length, with the long cylindrical shape of *Epigrus* but with the peristome entire, its inner margin separate from the body whorl. The apex is bulbous and, though the shell substance is sub-translucent, it is pale brown, not colourless as in the typical *Epigrus*. Its exact generic position is doubtful and it could logically come under *Scrobs* or even *Saltatrix*.

Genus **Saltatrix**, gen. nov.

Genotype, *Epigrus protractus* Hedley.

Minute, cylindrical, elongate, few-whorled, becoming uncoiled in the later stages, imperforate, the aperture oval, peristome entire and flattened, reflected all round.

Saltatrix protractus Hedley. (Fig. 63.)

Hedley 525.

This curious little shell, known to collectors as "The Dancing Lady", is so unlike other rissoids that it has been considered best to give it a new generic name. The uncoiling of the last whorl is characteristic, also its elongation in the line of the spire, as is also the oval mouth. The figured specimen is from 6–9 fathoms, Sow and Pigs Reef, and is 1·2 mm. in length. We also have it from the mud flats, North Harbour. The colour is pale brown and the shell substance sub-translucent.

Genus **Microdryas**, gen. nov.

Genotype, *Cingula australiae* Frauenfeld.

Shell minute, conical to cylindrical, few-whorled, imperforate, colourless and translucent, sculpture numerous fine, parallel, spiral, incised lines. Aperture ovate, expanded, angled posteriorly. Peristome entire, but thin on inner margin.

Microdryas australiae Frauenfeld. (Fig. 65.)

Novara Exped., Moll., 1867, p. 14, pl. 2, fig. 23.

Hedley 501.

This curious little species has been much confused in Australian literature. Hedley included it under *Merelina* in his check list and excluded Brazier's *ochroleuca* as a synonym. Elsewhere in this paper *ochroleuca* has been restored, for it is nothing like Frauenfeld's description or figure. The type locality is given as "Sidney", but it is evidently not a common species, for it has not since been seen from Port Jackson. We have, however, found three specimens in shell sand from Port Stephens, the figured one 1·4 mm. in length; and one from Cronulla. All of these agree very well with Frauenfeld, and this is evidently the long-debated species. As Frauenfeld's paper is not generally accessible, a liberal translation of his description, combining the Latin and the German, is here given as follows: Shell pointed conical, shiny, horn-coloured (?), matte, slightly translucent, 6 whorls loosely arched, sutures scarcely indented, on upper one 4, on last 7 spiral lines equi-distant, fine and strongly incised. Mouth one-third of entire height, oval, on top slightly angular, rounded below, margin blunt but not specially thickened. Length 2·4 mm., width 1·1 mm.

It has been very difficult to assign this species to any known Australian genus, and it has been necessary to propose a new one for its reception. *Epigrus iravadiodes* Gabriel and Gatcliffe should also be transferred to *Microdryas*. It may possibly be a synonym of *australiae*.

Microdryas elongata, sp. nov. (Fig. 66.)

Shell small, cylindrical, elongate, colourless and translucent, texture glassy. Aperture ovate, expanded, particularly anteriorly, where it extends well beyond the body whorl. Peristome entire but thin. Whorls 4½, the first 1½ inflated and smooth, the remainder rounded, sutures impressed. The body bends in very sharply to meet the aperture, giving a characteristic contour. The sculpture on the last three whorls consists of very numerous, fine, distinctly incised, equi-distant, spiral lines. Length 1·8· mm.

Locality.—Two specimens from shell sand at Narrabeen (type).

This species fits in fairly well with the generic characters assigned to *Microdryas*, and in texture and sculpture resembles *M. australiae*. It is, however, larger, more elongate, the aperture is more expanded anteriorly, and the apex is much larger and more inflated.

Genus **Attenuata** Hedley.

Genotype, *A. integella* Hedley.

"Shell tall, slender, cylindrical, thin, colourless and translucent, many whorled. Aperture sub-circular, peristome complete, inner lip reflected over an umbilical furrow. Sculpture, numerous, sharp, spiral, parallel keels."

From this description *Attenuata* may be separated from *Microdryas* by the much greater number of whorls and by the nature of the aperture.

Attenuata integella Hedley. (Fig. 67, after Hedley.)

Hedley, Proc. Linn. Soc. N.S.W., xxix, 1904, p. 185, pl. 9, f. 20.

The type locality is 100 fathoms, 16 miles east of Wollongong. We have not yet obtained this species, which is apparently confined to very deep water.

Genus **Coenaculum** Iredale.

Genotype, *Attenuata minutula* Tate and May.

Iredale (1924, p. 245) separated this generically from *Attenuata* and considers it does not belong to the Rissoidae at all. Tate and May originally placed the type species in *Scalaria*. There are many odd species of gasteropods whose generic determination at present is largely a matter of guesswork, and until something is known of their anatomy and life history their systematic position must remain in abeyance. Iredale does not give any generic description, but for future reference the following characters may be noted. Shell minute, elongate, with angular whorls and strong transverse sculpture. Aperture sub-circular, expanded, peristome interrupted, outer margin reflected. Apex keeled and lirate.

Coenaculum minutula Tate and May. (Fig. 68.)

Hedley 510; May 425.

This species occurs in shell sand in various localities along the coast, though we have not seen it alive. The figured specimen, 2·4 mm. in length, comes from Port Stephens.

Genus **Subonoba** Iredale.

Subonoba bassiana Hedley.

Hedley, Zool. Results "Endeavour", 1, 1911, p. 108, pl. 19, f. 25.

Iredale (1924, p. 244) records this Tasmanian species from 50–70 fathoms off Green Cape, at the same time introducing the new generic name *Botellus*. He gives no generic characters for *Botellus*, nor indeed for his other genus, *Subonoba*, but only remarks that "the circular mouth separates this group from any other of the Austral rissoid series". Under the circumstances it would seem well that either *Botellus* be rejected or at least held in abeyance until some generic characters can be specified. I have not yet seen this species, so for the moment it is retained in the New South Wales list without further comment.

Genus **Notosetia** Iredale.

This is another of Iredale's genera for which no generic characters at all are stated, the only information given being that the type is *Barleira neozelandica* and that it covers a heterogeneous assembly. Hedley used the genus in his check list, and as far as possible we have followed his interpretation, though some revision has been found necessary.

Included under *Notosetia* are small to minute shells, mostly living on algae, with few rounded whorls, the body whorl large and inflated, thin, shell substance varying from an eggshell to a vitreous texture, generally white or with yellow bands, but some species coloured from yellow to purple. Aperture sub-circular, peristome incomplete, inner margin reflected over columella producing an umbilical furrow. Operculum horny, sometimes white and transparent.

In view of the large number of species here proposed, a certain amount of criticism may be anticipated. The simple nature of the shell makes it difficult to find strong shell characters on which to base specific descriptions; moreover, many of the species are very close to each other, so much so that much beach material will always be unidentifiable. It is only by collecting long series of living specimens and by sorting beneath the microscope that the differences can be seen, and it is then surprising how constant, though small, these differences are and how readily the various species can be separated.

It may be noted that with the minute species colour is a very useful first guide in sorting, either the colour of the shell itself or of the animal showing through the transparent whorls.

Notosetia fulva, sp. nov. (Fig. 69.)

Shell minute, thin, horny, deep yellow-brown, translucent. Whorls three, the first small and dome-shaped, the others rapidly expanding, rounded, sutures deeply impressed. Body whorl very large and inflated. Aperture large, expanded, peristome incomplete, rounded and thin on outer margin, reflected anteriorly over the columella, inner margin curved. There is no sculpture and the surface is smooth and shining. Operculum horny, details not ascertainable, but nucleus apparently sub-marginal. Length 1 mm.

Habitat.—Alive under stones at Long Reef (type); also in Galiolaria tubes, North Harbour.

The minute size and colour are good recognition points. In general form this species greatly resembles *N. fusca*, described below, with which it is associated in North Harbour, but, while the differences are not great, the colour enables them to be readily sorted.

Notosetia procincta Hedley. (Fig. 70.)

Hedley 531.

The largest of the group, the figured specimen from Ocean Beach, Manly, 2·5 mm. in length. It is not uncommon on ocean beaches right along the coast. Two pale yellow bands are a good recognition point, but these are not always present and fade rapidly on beach-worn specimens. We have not seen this species alive.

Notosetia nitens Frauenfeld. (Fig. 71.)

Hedley 530; May 470.

This species resembles the last one, but is smaller, the figured specimen, found alive on algae (*Graciolaria* sp.), being 2 mm. in length. It is also relatively broader.

The two brown bands mentioned by Frauenfeld are very faint and are sometimes absent. The operculum is horny, pauci-spiral, and crossed with numerous growth lines. We have also found it alive in mussel beds on the Bottle and Glass Rocks.

Notosetia pellucida, sp. nov. (Fig. 72.)

Shell minute, thin, smooth, colourless, glassy and transparent. Whorls 4, the first dome-shaped, remainder rounded, sutures deeply impressed. Aperture sub-circular, peristome thin, outer margin rounded, inner margin arched, reflected over the columella, producing an umbilical fold, expanded anteriorly. There is no trace of any sculpture. Operculum thin and horny, apparently smooth, but details could not be observed. Length 1·5 mm.

Habitat.—Alive on algae, North Harbour, fairly common.

This is very like the two preceding species, but is again smaller and differs in details of contour and aperture that can be better seen in the figures than by description.

Notosetia simillima May. (Fig. 73.)

May 473.

A pure white shell, the texture varying from white and opaque to an alternation of transverse opaque and translucent bands. This is very close to *N. nitens* and was at first thought to be a variety. May in his check list also expresses the same doubt. But *simillima* possesses an extra whorl, five against four in *nitens*, and the differences, being constant over such a distance, warrant the retention of the species. This is a new record for New South Wales. We found it abundantly on the reclamations at Bayview, Pittwater, the figured specimen 2 mm. in length; also on the reclamation at The Spit, Middle Harbour.

Notosetia fusca, sp. nov. (Fig. 74.)

Shell minute, thin and translucent, horny, deep brown. Whorls three, the first dome-shaped, the others rounded, body whorl comparatively very large and inflated, sutures deeply impressed. Aperture sub-circular, angled posteriorly, expanded posteriorly, peristome thin, reflected over the columella, umbilical furrow fairly deep. There is no sculpture except faint growth lines, and the surface is smooth and shiny. The operculum is comparatively thick, horny, and transparent, but appears white and stony from the attaching muscle, its details as far as can be detected as in the illustration. Length 0·8 mm., but some specimens are slightly larger.

Habitat.—Alive on seaweed, North Harbour (type); also on weed at Yamba on the north coast; and in *Galeolaria* tubes, North Harbour associated with *Notosetia fulva.*

Very close to *N. fulva*, but separable by the colour, which, though not great, is quite distinctive; also by minor differences of contour and aperture.

Notosetia aethiopia, sp. nov. (Fig. 75.)

Shell minute, thin, horny and sub-translucent, very deep, blackish-brown. Whorls three, the first dome-shaped, the others rounded, body whorl inflated but less than in *N. fusca*, sutures impressed. Aperture broadly ovate, slightly angled posteriorly, peristome thin, reflected over the columella, expanded posteriorly. Sculpture very faint growth lines, surface shiny. Operculum similar to *N. fusca.* Length 1·2 mm.

Habitat.—Alive in abundance in *Galeolaria* tubes between tide marks, North Harbour (type), and in mussel beds, Bottle and Glass Rocks.

This species is very close to *N. fusca*, but can be readily separated by its deeper colour, which is almost black. It is also narrower, the second whorl is relatively much larger, and the body whorl less inflated.

Notosetia galbinia, sp. nov. (Fig. 76.)

Shell minute, thin, glassy and sub-translucent, pale yellowish. Whorls four, the first dome-shaped, remainder rounded, body whorl moderately inflated, sutures impressed. Aperture ovate, expanded, peristome thin, rounded on outer margin, inner margin nearly vertical and strongly reflected back over the columella, expanded anteriorly. Umbilical slit narrow and well defined. There is no sculpture and the surface is smooth and shining. Operculum similar to that of *N. fusca.* Length 1·5 mm.

Habitat.—Alive in seaweed, North Harbour (type); also on seaweed at Long Reef.

This is somewhat larger than either of the two preceding species, it has an extra whorl, differs in details of the aperture, and can be readily sorted by the pale yellowish colour.

Notosetia atropurpurea Frauenfeld. (Fig. 77.)

Hedley 529.

This species is allied to *N. fusca* and the preceding species, but can be readily recognized by its purple colour and white apex. Again there are small but constant differences in contour and aperture. We found a few specimens living on seaweed at Shellharbour, but the operculum was so far retracted as to be practically invisible. It was abundant in dredgings from 6–9 fathoms, Sow and Pigs Reef, the figured specimen 1·3 mm. in length; and also from the reclamation at Bayview, Pittwater.

Notosetia castanea, sp. nov. (Fig. 78.)

Shell minute, thin, sub-translucent, colour bright chestnut. Whorls four, the first dome-shaped, remainder rounded, body whorl inflated, sutures deeply impressed. Aperture ovate, angled posteriorly, expanded anteriorly, peristome thin, rounded on outer margin, reflected over the columella on inner margin, umbilical furrow deep. There is no sculpture and the surface is smooth and lustrous. Operculum retracted too far to be visible. Length 1·1 mm.

Habitat.—Living in *Galeolaria* tubes, North Harbour (type).

Once again the colour is a useful guide to identification, but as with the other species of this group, small differences of contour and the aperture are constant.

Genus **Obtortio** Hedley.

Under *Obtortio* are included elongate, many-whorled shells, with small apices and strong sculpture, both spiral and transverse. The former may predominate or the sculpture may be strongly cancellate. There is a tendency for the median whorls to increase rapidly, with but little subsequent increase to the body-whorl, so that the whole shell appears to bulge somewhat in the centre. The peristome is incomplete and rather thin. Some species are not unlike *Bittium* in appearance, but of course have no anterior canal.

The systematic position of *Obtortio* is still very obscure. Hedley originally included it in the Pyramidellidae, but later transferred it to the Rissoidae. Within the present more restricted limits of this family it hardly seems in place, but it is difficult to suggest other relationship. Further investigation will possibly show that it should be placed in a family by itself.

Obtortio lutosus Hedley. (Fig. 79.)

Hedley 545.

This is a very distinctive species, easily recognized from the figure. We have dredged it in six fathoms, North Harbour, the figured specimen 3·8 mm. in length; and it also occurs in the reclamations at Bayview, Pittwater.

Cithna angulata Hedley. (Fig. 85.)

Hedley 546; May 492.

The generic characters assigned to *Cithna* apply also to the species *angulata*, which is common and widespread on the continental shelf. Hedley records it from numerous stations, from off Port Stephens, from 40–50 fathoms off Cape Three Points, and from 100 fathoms off Wollongong, etc. We have it quite commonly from 20–35 fathoms off Crookhaven. The length of the figured specimen is 2·8 mm.

Genus **Laevilitorina** Pfeffer.

This is another genus to which it is difficult to ascribe definite generic characters. Hedley states that he compared it with Pfeffer's genotype, *L. caliginosa*, with which it closely corresponds. Selected characters from the one Australian species are the sharp spire, large inflated aperture with the peristome widely reflected almost into a plate on the inner margin, and the brown, horn-like texture of the translucent shell.

Laevilitorina mariae Ten.-Woods. (Fig. 86.)

Hedley 532; May 474.

We have taken this species alive on seaweed at Ballina, the length of the figured specimen 1·7 mm. It does not seem common on the coast, though single specimens are sometimes found on the ocean beaches, and its range extends to Tasmania. The operculum is thin and horny, but is retracted too far into the wide aperture to observe details.

Genus **Diala** Adams.

Diala is a well-defined and natural genus with a recognizable facies, yet with few characters which lend themselves to comparative description. It is medium-sized for the family, elongate and conical, with moderately rounded whorls increasing regularly, thin, texture varying from transparent to nearly opaque, generally decorated with spots or streaks of brown. The aperture is moderately expanded, the peristome interrupted, thin and not reflected, and there is no umbilical slit. It is a typical weed-liver, and is abundant in this habitat on southern as well as eastern Australian coasts. Species show considerable individual variation in form, so much so that at first sight a great many species seem to be indicated. Examination of long series, however, reduces these to four, within the limits of each of which is much variation. Shell texture and general facies are the best guides to specific determination, and the following key may be useful:

A. Transparent.	*a*. Smooth	*translucida.*
	b. Lirate	*lirata.*
B. Translucent		*phasianella.*
C. Nearly opaque		*lauta.*

The nodulose species, *D. monile* Adams, is here rejected as an aberration of more than one species (see Figs. 88, 92 and 93). This condition has long puzzled systematists. The development of swellings and nodules, particularly on the median whorls, has led to a number of specific names, such as *monile*, *pagodella*, etc. Where these have been figured by more than one author there has been considerable disagreement and none of the drawings agree. This applies particularly to the New South Wales species known as *D. monile*. In fact, examination of any large series of any species shows that there is a tendency in some individuals to develop nodulation to a greater or lesser extent. As a rule the nodules are more prominent on the middle and particularly the penultimate whorls, while the earlier and body whorls may be quite smooth. The character seems to begin as a rounded swelling of the shell just above the suture, developing into a number of low, rounded protuberances, as in Figure 88 (*Diala* *phasianella*). In a more extreme example the protuberances are larger, as in Figure 92 (*D. lauta*), and may become so prominent as to give the shell a rugose and pagoda-like appearance (Fig. 93, *D. lauta*). Every stage between these extremes can be found. A possible analogy exists in the curious development of large hollow nodules on the body whorl of some specimens of quite another shell on our coast, *Turbo miliaris*. It is impossible at this stage to hazard a guess at the cause of this nodulation, but whether it is induced by disease or is the incipient stage of further evolution, it is a character which apparently has no value for taxonomic purposes, and species based on it must be rejected.

Diala phasianella Angas. (Figs. 87, 88.)

Hedley 543.

Variable in form, but the whorls are generally flatter than in other species and are neither completely transparent, as in *D. translucida*, nor with the nearly opaque, rather eggshell texture of *D. lauta*. It generally has also more colour than the other species, the commonest decoration being a line of brown spots on the middle of the body whorl; but other individuals show irregular, transverse, brown lines. The brown spots are sometimes replaced by white, opaque patches. In some specimens where the nodulation is present there seems to be a definite connection between it and the pigmentation.

The species probably lives below low tide, for though it is common on beaches within the harbour, we have not taken it alive. The figured specimens come from North Harbour and are each 4 mm. in length.

Diala translucida Hedley. (Fig. 89.)

Hedley 491; May 491.

This species can be recognized by its transparency. Like *D. phasianella* it is very variable in form, and may be quite broad or comparatively elongate. It shows a few brown markings occasionally, but the most common decoration is a line of opaque spots just above the suture or on the centre of the body whorl. It is abundant living on seaweed in rock pools or on piles, and though found on the outer reefs is more typical of the calmer waters within the harbours. The figured specimen, 4 mm. long, comes from weed on wharf piles at Toronto, Lake Macquarie, where it is very abundant. We also have it from seaweed at North Harbour, Port Jackson; Huskisson, Jervis Bay; Long Reef and other localities.

Diala lirata, sp. nov. (Fig. 90.)

Shell elongate, conical, variable in form, many specimens comparatively broad, thin, transparent in beach specimens, translucent and yellowish when alive, colourless when found on the beach except for a few faint brown markings, but decoration generally consisting of a line of opaque spots similar to those in *D. translucida*. Whorls nine, initial whorl small and rounded, the others increasing regularly, slightly rounded, sutures impressed. Aperture rounded on outer margin, inner margin arched, slightly expanded anteriorly. Peristome interrupted, thin, not reflected, inner margin nearly straight. Sculpture numerous, very fine but distinct, regular spiral striations, slightly pitted, and completely covering the shell right to the base. Length 5·5 mm.

Habitat.—An exceedingly common species, living on weed in many localities, both inside the bays and on the outer coast. The type comes from *Sargassum* sp. adhering to piles at Toronto, Lake Macquarie. We also have it from seaweed at Brunswick Heads; Point Halliday; Long Reef; North Harbour, Port Jackson; and from the beach at Port Stephens.

This in facies is a typical *Diala*, though the lirate sculpture would suggest another genus. It has been apparently overlooked in the past, as the sculpture is only visible under a fairly strong lens. It is commonly associated with *D. translucida* and in the live state is not always easy to separate without close examination.

Diala lauta Adams. (Figs. 91, 92, 93.)

This may be recognized by the general absence of colouring, the typically elongate form with rather flattened whorls, and by its nearly opaque texture. Like the other species, it is very variable in form. It lives in rather deeper water, and though found on the beaches is more commonly taken in depths of from four to six fathoms in the harbour. We have not found it alive. Of the figured specimens, No. 91, 5 mm. in length, comes from North Harbour; No. 92, 4·5 mm. in length, from the same locality; and No. 93, 6 mm. in length, from Balmoral.

The majority of specimens which have been labelled *D. monile* may be assigned to *D. lauta*, and probably *D. pagodella* is but a nodulated variety of this or an allied species.

Genus **Laevitesta**, gen. nov.

Genotype, *Laevitesta scobina* Laseron.

Shell conical, pointed, small, thin, variable, aperture ovate, peristome thin, interrupted, but almost entire on old specimens, very slightly reflected, umbilical slit deep, sutures channelled, sculpture strongly radially lirate, continuous through the shell and thus reversed on the interior.

But for its thin shell this would pass for a *Lironoba*, yet in its general facies it resembles *Diala*.

Laevitesta scobina, sp. nov. (Fig. 94.)

Shell small, thin, conical, pointed, somewhat variable in form, uniformly brown or white with faint brown markings, the latter probably bleached. Whorls seven, initial whorls very small and rounded, remainder increasing regularly, flattened to slightly rounded, sutures channelled. Aperture ovate, rounded on outer margin, inner margin curved. Peristome thin, nearly entire, particularly in old specimens, slightly reflected on inner margin, which is curved, the umbilical slit deep and well defined. The sculpture consists of numerous, well-defined, sharp, spiral ridges, about seven on the earlier whorls and about 15 on the body whorl, separated by narrow, well-defined channels. The sculpture is impressed right through the shell and is visible on the interior, but not so sharply. Length 3·2 mm.

Locality.—Abundant from the reclamations, Bayview, Pittwater (type); and also from the reclamations at The Spit, Middle Harbour.

This interesting little species, though abundant in certain localities, has apparently been overlooked, as at first sight it appears very ordinary and undistinguished. The sharp, well-defined, lirate sculpture, visible on the interior of the shell, the thin yet strong shell, and channelled suture are good recognition points.

Genus **Heterorissoa** Iredale.

Heterorissoa wilfredi Gatliff and Gabriel.

Proc. Royal Soc. Victoria, xxiv, 1911, p. 188, pl. xlvi, f. 3.

This was recorded from shallow water in Twofold Bay by Iredale (1924), who remarks also that he has found it not uncommon on the Sydney beaches. So far, however, we have not identified it from the Sydney area, and lack data to offer further information.

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Unfigured species: *Rissoina lintea* Hedley and May; *Subonoba bassiana* May; *Rissopsis maccoyi* Ten.-Woods; *Heterorissoa wilfredi* Gatliff and Gabriel.

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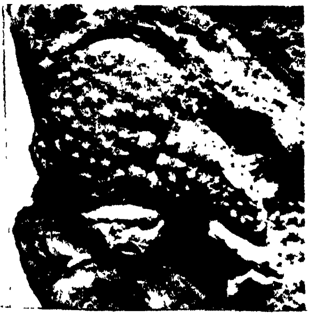

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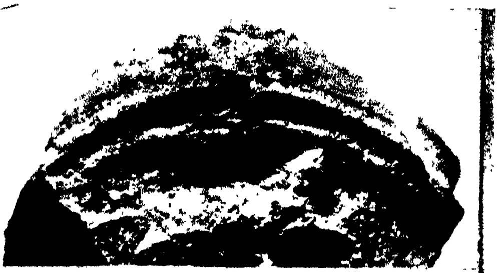

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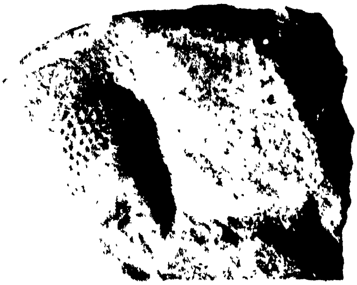

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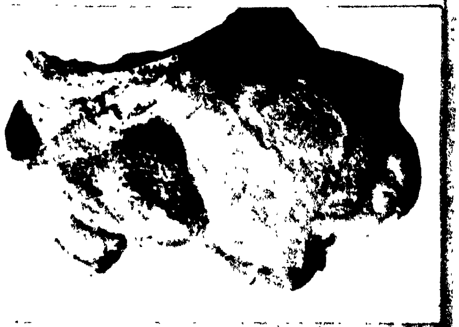

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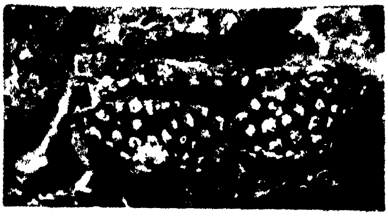

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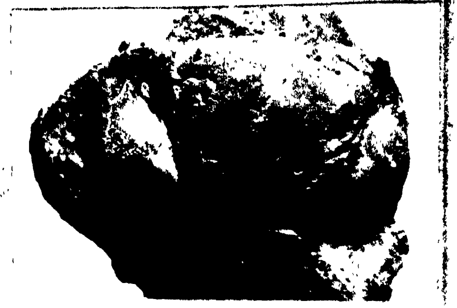

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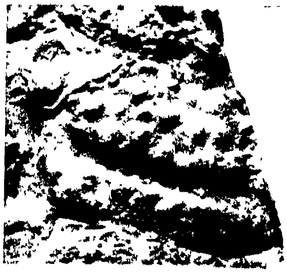

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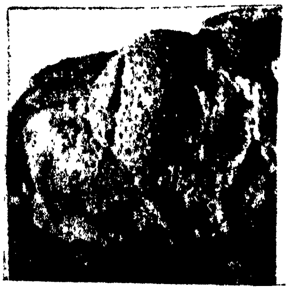

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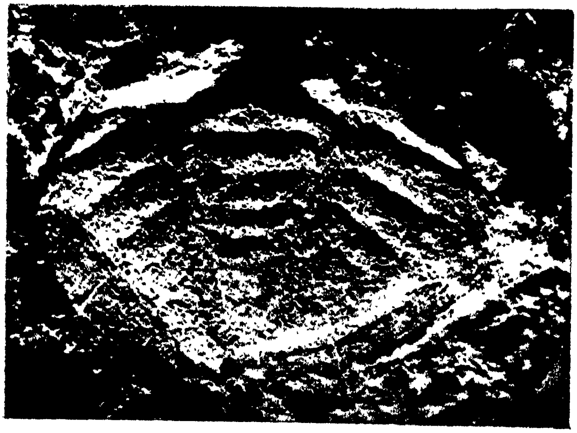

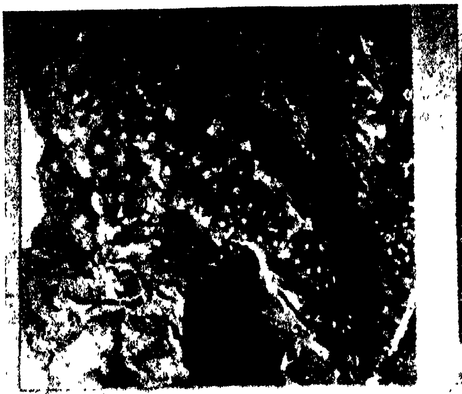

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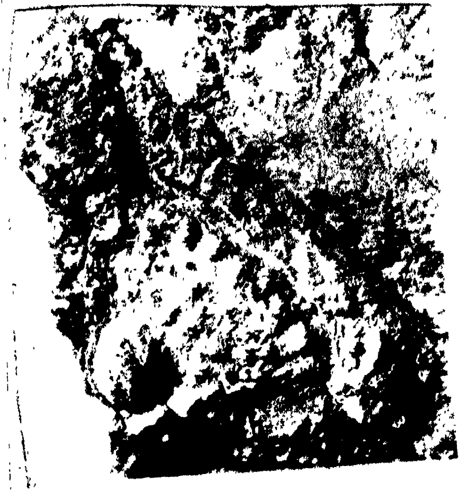

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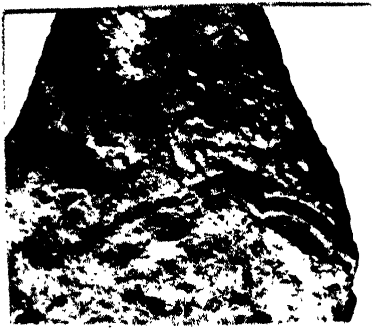

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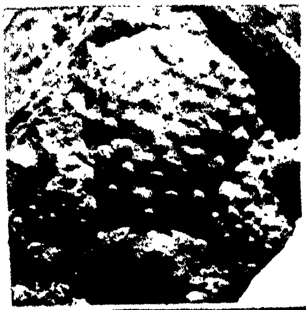

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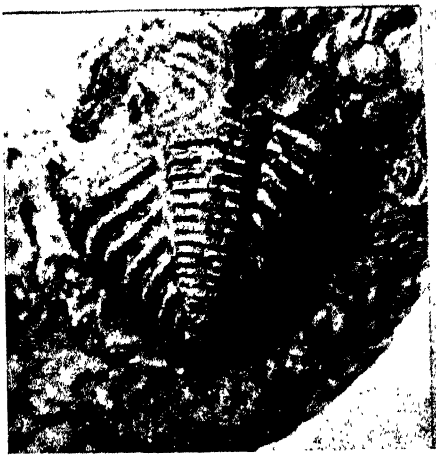

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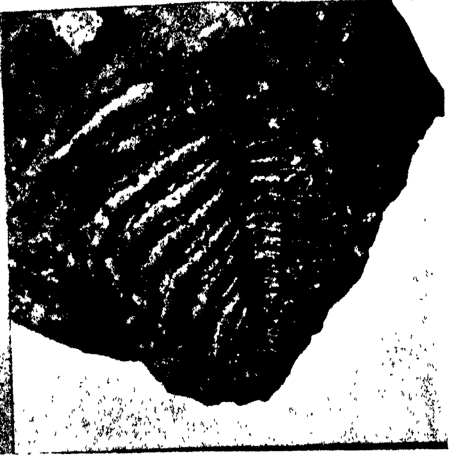

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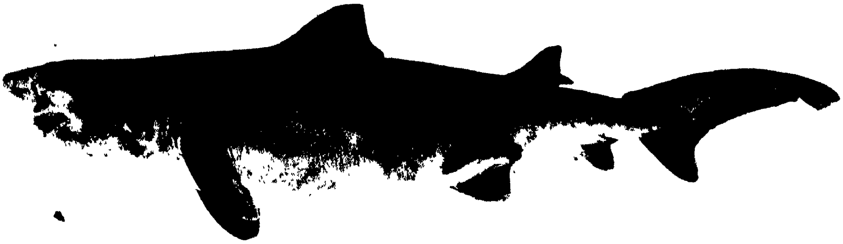

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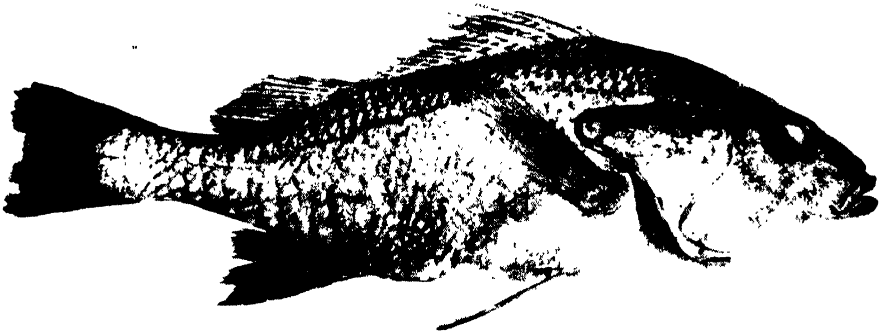

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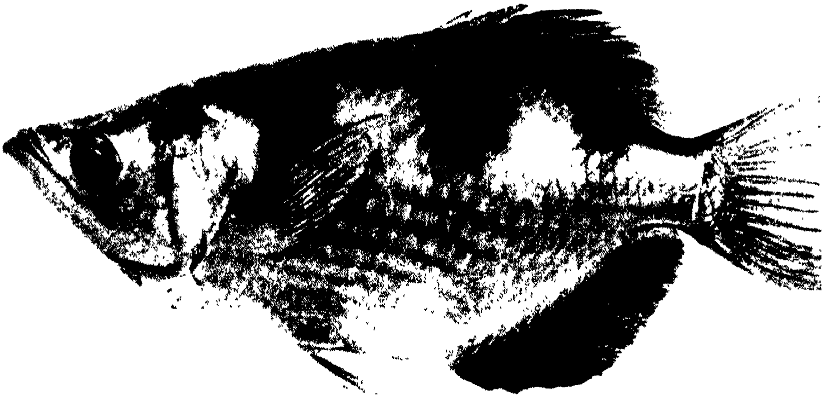

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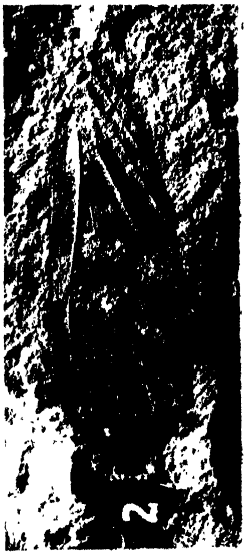
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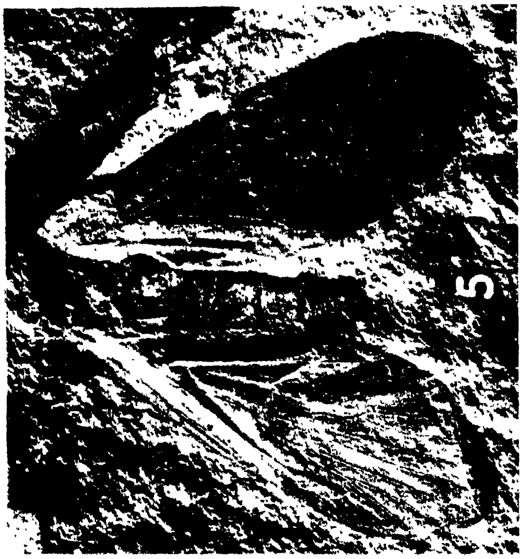
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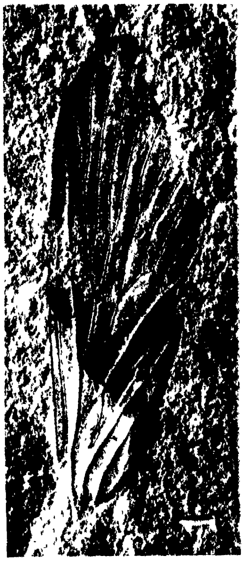
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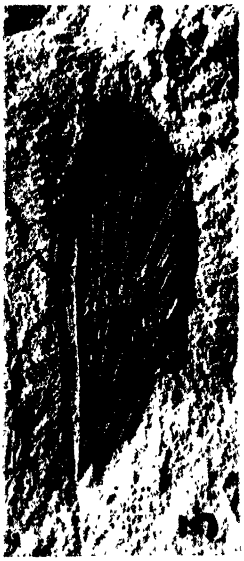
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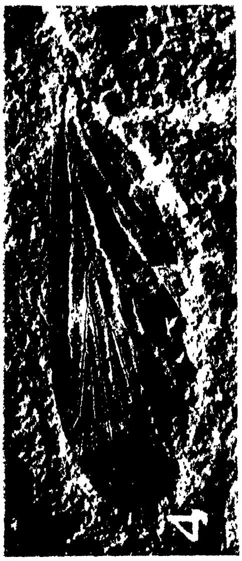
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6 MAY 1953

REPORT ON SOME PARASITIC NEMATODES FROM THE AUSTRALIAN MUSEUM.

By T. HARVEY JOHNSTON and PATRICIA M. MAWSON,
University of Adelaide.

(Figures 1–7.)

In 1943, Dr. A. B. Walkom, Director of the Australian Museum, Sydney, submitted to us for identification and report, a collection of parasitic nematodes from various hosts. Much of the material formed part of the " Old Collection " of the Museum and contained little or no information beyond the popular name of the host. Some of it was obtained by the Commonwealth Fisheries Investigation Steamer, " Endeavour", during 1909, 1910 and 1914. Unfortunately, during transit, some of the tubes became smashed and their contents distributed amongst the packing material, but by careful unpacking we have been able to associate most of these worms with proper labels. We have assumed, unless there are any reasons to the contrary, that unlocalized material came from New South Wales.

We express our thanks to Dr. Walkom for the opportunity to study the collection which has now been returned to the Australian Museum. Mr. G. P. Whitley, at the request of the Director, kindly endeavoured to identify some of the unnamed " Endeavour " fish hosts from which nematodes were collected, by reference to the records, reports and collections associated with the work of the vessel, but he reported that no data were forthcoming regarding those specimens which were not numbered but which had evidently been opened up and discarded many years ago. Mr. J. R. Kinghorn supplied identifications of some of the reptilian hosts. We acknowledge indebtedness to the Commonwealth Research Grant to the University of Adelaide. The host names and parasites identified are as follow :

ELASMOBRANCHS.

Emissola [*Mustelus*] *antarctica* Gnthr.—*Eustoma australe* (J. and M., 1945), N.S.W.; *Terranova chiloscyllii*, sp. nov., N.S.W.

Chiloscyllium punctatum Mull. and Henle.—*Terranova chiloscyllii*, sp. nov., Keppel Is., Queensland.

Heterodontus portusjacksoni Meyer.—*Paraleptus australis* J. and M., N.S.W.

Pristis zysron Bleeker.—*Stomachus* sp. (juveniles), Manly, N.S.W.

Pristiophorus cirratus Lath.—*Eustoma australe* (J. and M.), N.S.W.

TELEOST FISH.

Congermuraena habenata Richdsn.—*Stomachus* sp. larvæ, Storm Bay, Tasmania.

Genypterus blacodes Bl. and Schn.—*Stomachus* sp. larvæ, Storm Bay, Tasmania.

Gadus morrhua Cuv.—*Contracaecum* (*Thynnascaris*) *aduncum* (Rud.). This material is not Australian.

Coelorhynchus (*Paramacrurus*) *australis* Richdsn.—*Stomachus* sp. larvæ, Montague Island, N.S.W.

Neoplatycephalus macrodon Ogilby.—*Stomachus* sp. larvæ, N.S.W.

Platycephalus bassensis C. and V.—*Contracaecum* (*Thynnascaris*) sp., Oyster Bay, Tasmania.

Ichthyscopus sannio Whitley.—*Stomachus* sp. larvæ, N.S.W. coast.

Zeus faber Linn.—*Contracaecum* (*Thynnascaris*) *aduncum* (Rud.), off Tathra Head, N.S.W.

Promicrops lanceolatus Bloch.—*Contracaecum* (*Thynnascaris*) *legendrei* Dollfus, Hummocky Island, Queensland.

Neosebastes scorpaenoides Guichenot.—*Stomachus* sp. larvæ, N.S.W.

Sciaena antarctica Castln.—*Stomachus* sp. larvæ, N.S.W.

Thyrsites atun Euphr.—*Stomachus* sp. larvæ, Pambula, N.S.W.; Woolooware Bay, N.S.W.; Investigator Strait, South Australia.

Caranx georgianus C. and V.—*Contracaecum* (*Thynnascaris*) *aduncum* (Rud.), Flinders Island, Tasmania.

Unnamed fish, " Endeavour " collection :—

A. Taken between Devonport and Launceston, Tasmania, *Stomachus* sp. larvæ.

B. Taken in 20 fathoms, off River Murray mouth, South Australia, June, 1909, *Contracaecum* (*Thynnascaris*) *aduncum* (Rud.).

C. Probably from " Endeavour " collection, ? locality, *Terranova* sp. larvæ.

REPTILES.

Varanus varius Shaw.—*Physaloptera antarctica* Linst., N.S.W..

Varanus gouldi Gray.—*Physaloptera antarctica* Linst., Mount Lyndhurst, South Australia.

Python spilotes spilotes Lacep.—*Ophidascaris filaria* Duj., N.S.W..

Python spilotes variegatus Gray.—*Ophidascaris filaria* Duj., N.S.W.; *Polydelphis anoura* Duj., N.S.W.; *Physaloptera* sp. encysted larvæ, N.S.W.

Pseudechis porphyriacus Shaw.—*Physaloptera confusa* J. and M., Tenterfield and Sydney, N.S.W.

Pseudechis australis Gray.—*Physaloptera confusa* J. and M., Immarna, East-West transcontinental Railway, South Australia.

Notechis scutatus Peters.—*Physaloptera confusa* J. and M., Sydney.

Denisonia suta Peters.—*Physaloptera confusa* J. and M., Narrabri, N.S.W. (host quoted as " *Denisonia frontalis*, black snake ").

" Sea snake."—*Polydelphis* sp., " Old Collection".

BIRD.

Anous minutus Boie.—*Stomachus* sp. (as ingesta from fish), Great Barrier Reef.

MAMMAL (Cetacea).

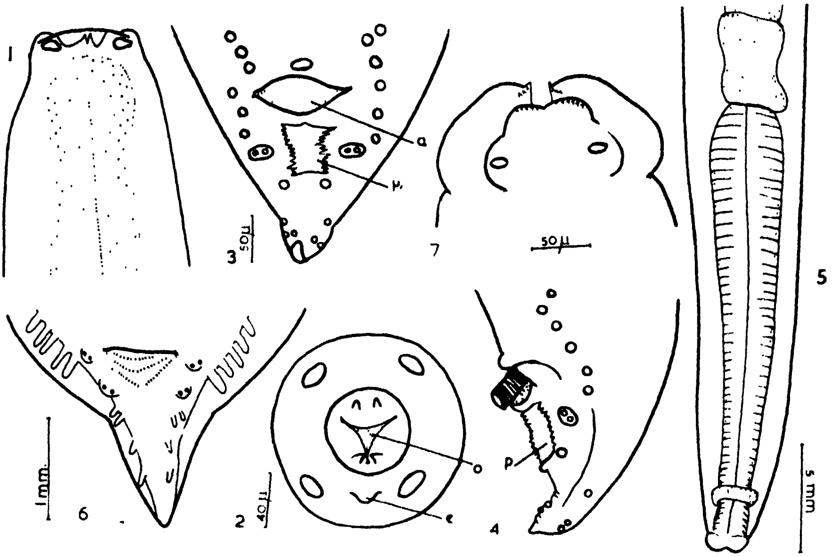
Globicephalus ventricosus Lacep.—*Stomachus oceanicus*, sp. nov., " Old Collection", presumably off the N.S.W. coast.

ASCARIDATA.
ASCARIDAE.
STOMACHINAE.

Eustoma australe (J. and M.)

This parasite was described by us (1945, p. 109) as *Anacanthocheilus australis* from *Mustelus antarcticus* from the Derwent River, Tasmania. We now record it from the same host species (*Emissola antarctica*) from the New South Wales coast; W.3361 off Jervis Bay, coll. G. P. Whitley, Dec. 1942; W.3370, W.3372, N.S.W. coast, coll. Miss E. Pope, July 1943; and from *Pristiophorus cirratus* W.3457, coll. Miss E. Pope, off N.S.W. coast.

Punt (1941) stated that *Eustoma* Beneden 1870 was sufficiently described to be considered a valid genus, its type being *E. truncata*, and that the latter was a synonym of *Ascaris rotundata* Rud. 1819. Hence *Anacanthocheilus* erected by Wülker in 1930 for Rudolphi's species falls as a synonym of *Eustoma*.



Figures 1–7.

1–4, *Terranova chiloscyllii.* 1 dorsal, and 2 " en face " views of head; 3 male tail, ventral, 4 male tail, lateral (Figs. 1–2 to same scale; 3 and 4 to same scale.)
5–7, *Stomachus oceanicus.* 5 oesophageal region; 6 male tail; 7 head.
a, anus; *e*, excretory pore; *o*, oesophageal lumen; *p*, postanal " plaque."

Pseudanisakis rajae Yamaguti 1941, which we transferred (1945, p. 107) to *Anacanthocheilus*, bears a striking resemblance to *E. rotundatum*, as redescribed by Punt, the sole significant difference being the position of the vulva which was stated to be situated further forward in the Japanese species. The latter is now transferred to *Eustoma* as *E. rajae* and is perhaps synonymous with *E. rotundatum*.

Terranova chiloscyllii, sp. nov.

(Figures 1–4.)

This species was found in collections from the stomachs of two sharks, *Chiloscyllium punctatum* (type host), W.3551, coll. G. P. Whitley from Halfway Island, Keppel Islands, Central Queensland Coast; and *Emissola antarctica*, N.S.W. coast, W.3368, coll. G. P. Whitley, March 1943.

The worms are long and slender, the males 37–40 mm. in length, and ·4 mm. in maximum diameter; the females 40–50 mm. long and ·56 mm. in diameter. The lips, if present, are very much reduced. They are not distinguishable from one another on the outer surface of the head; in an " en face " view there appears to be a circular " mouth", leading to a depression in which lie three lobes, corresponding to the three parts of the œsophageal wall. We are uncertain as to whether these structures should be regarded as vestiges of the lips, or as the anterior end of the oesophagus, which latter they closely resemble. One of these is dorsal, the other two subventral, in position. The dorsal bears two teeth, the subventrals each one tooth. Four large papillæ are present on the outer surface of the head, two subdorsally and two subventrally.

The œsophagus, excluding the ventriculus, is 2·4–2·5 mm. long in the male, 2·6 mm. in the female. The ventriculus is 2·7–3·6 mm. in length in the male, 3·6 mm. in the female. The intestinal cæcum is as long as the ventriculus, except in the youngest male, in which it is rather shorter. The ventriculus communicates with the intestine by an oblique foramen. The nerve ring and cervical papillæ are at almost the same level, namely, ·4–·5 mm. from the head end. The excretory pore opens between the two subventral cephalic papillæ.

The vulva is situated at the end of the first third of the body length. The eggs are thin-shelled and subglobular, 35–40μ in diameter.

The spicules are equal, 1–1·2 mm. long, strongly chitinized and ending in rather blunt tips. The tail narrows greatly behind the anus which is ·18 mm. in front of the tip. There are 35–45 pairs of small adanal and preanal papillæ; a pair of large double papillæ shortly behind the anus, and behind them four pairs of caudal papillæ. A median preanal papilla is present. On the ventral surface of the tail just posterior to the anus is a stout plaque-like structure of chitin, 60μ long and about 30μ wide, whose lateral edges are serrated, and in three oval areas in its central portion the chitin is very much thinner. This structure is comparable with similar chitinizations occurring in the male of other species of *Terranova* from elasmobranch fishes, namely *T. galeocerdonis* (Thwaite) and *T. scoliodontis* (Baylis).

T. chiloscyllii resembles species of *Acanthocheilus* in the reduction of the lips, but the presence of a ventriculus and an intestinal cæcum allies it with *Terranova*. The male tail bears a marked similarity to that of other species of *Terranova* from elasmobranchs. The greater length of the ventriculus compared with that of the muscular œsophagus is a striking feature of our species.

The type of genus, *T. antarctica*, was described by Leiper and Atkinson (1915, p. 28) from a female worm from *Mustelus antarcticus* (*Emissola antarctica*) from the Bay of Islands, New Zealand. The parasite was 32 mm. long, 3 mm. in maximum breadth, and coiled in 1½ spirals; with three rounded squat lips, not markedly separated from the neck; without an oesophageal appendage but with a large intestinal cæcum. Baylis (1920, p. 258) re-examined the specimen and reported that a ventriculus, 1·4 mm. long, was present. Leiper and Atkinson stated that the anterior end of the caecum was 1 mm. from the head of the worm, hence if their figure 1 is drawn to scale, the oesophagus was about 1·6 mm. in length and was therefore only slightly longer than the ventriculus as reported by Baylis. The vulva was stated to be 14 mm. behind the head, i.e., just in front of the midlength, whereas in *T. chiloscyllii* it lies at the end of the first third of the body length. A re-examination of the type may indicate that our species is synonymous with *T. antarctica*.

We pointed out recently (J. and M., 1945) that the genus *Terranova* was valid because its species possessed head characters different from those of the closely related *Porrocaecum* with which it was usually synonymized.

Terranova sp. larva.

Among debris from several broken tubes was part of the mesentery of a fish (W.3563), containing numerous larval ascarids referable to the genus *Terranova*. The fish host presumably belonged to the "Endeavour" collection, but its name and locality were not indicated. In view of the fact that relatively few seals are found in Australian waters, and that the proportions in any case do not resemble those of *T. piscium* or *T. kogiae*, the only recorded species of the genus from marine mammals, it is considered likely that the final host is an elasmobranch. The larvae might be those of a *Porrocaecum* sp., but no such species has been recorded from Australian fish-eating birds.

The larvae are all loosely coiled or curved, each lying in a cast skin with the head outwards, outside which is a capsule of host tissue roughly following the form of the worm. The lips are absent and a larval tooth is present. The alimentary canal is well differentiated. The nerve ring is ·2 mm. distant from the head end in all specimens preasured. The tail ends in a point without spines. The cuticle around the anus is very mominent.

The smallest larva in the collection is 3·65 mm. long, coiled in a loose flat spiral. In this specimen the oesophagus is ·5 mm. long, excluding the ventriculus ·2 mm. long; and the intestinal caecum is ·4 mm. In the longest specimen, 7·2 mm. in length, the oesophagus is ·85 mm. long, the ventriculus ·35, and the caecum ·7 mm. In the numerous specimens between these sizes the proportions of these parts are similar, i.e., the ratio of the ventriculus to the rest of the oesophagus is about 1 : 2·5, and the ratio of the ventriculus to the intestinal caecum is about 1 : 2 (1 : 1·8–1 : 2·2). There is no indication in this collection, nor in *Terranova piscium* larvae recorded by us from subantarctic fish (J. and M., 1945) of an increase in the relative length of the intestinal caecum with increasing length of the larvae. Such a growth was recorded by Baylis (1916) after his examination of material from a number of collections. It seems to us possible that he was dealing with larvae belonging to more than one species and genus. Since the very small encysted larvae in the present collection have well-developed intestinal caeca, it seems to us probable that the differentiation of the alimentary canal takes place at an earlier stage than in these presumably fourth-stage larvae. A comparison with *Contracaecum* larvae which are far commoner in fish examined by the present authors, may be helpful here. We described (J. and M., 1945, p. 126, Figures 13–20) very young larvae (Figure 13) penetrating the intestinal wall of the fish host as having no intestinal caecum (though an oesophageal appendix was present). Later stages with a rudimentary caecum (Figures 15–16) were found in cysts (Figure 14) in the mesenteries of fish. Still older larvae, presumably fourth stage (or third stage if Punt's suggestion of there being only three moults in *Contracaecum* spp. be correct) were found loosely encapsuled in the mesentery, at least one cast skin being present under the host-formed capsule, and in these fourth (or third) stage larvae an intestinal caecum was well developed. It is these larvae which are comparable in degree of development with those in the present collection.

Stomachus oceanicus, sp. nov.

(Figures 5-7.)

Numerous worms from a " black fish " (W.3555, without number or locality) are identified as a new species of *Stomachus*. Since the adult stage of members of this genus occurs in cetaceans, we feel justified in considering the host to be *Globicephalus ventricosus* Lacep. (syn. *G. melas* Traill), which is popularly termed " black fish". Specimens of this small odontocete are occasionally found stranded along the coast of New South Wales and elsewhere.

The males are up to 45 mm. long; females to 55 mm. The dorsal lip is shorter than the ventral; each lip has two anterior lobes, each lobe bearing on its inner side a dentigerous ridge with about six to eight denticles. The oesophagus is 3·6 mm. in length in the longest specimens of both sexes, widening towards its base. The ventriculus is ;6 mm. long, and constricted at its middle (Figure 5). The nerve ring is ·42 mm., and cervical papillae ·66 mm., from the head end.

The vulva is very small, 11 mm. from the head end in females 29 mm. long (1 : 2·6 of body length). The thick-shelled eggs are almost spherical, 35–40μ in diameter.

Spicules are slightly unequal, the smallest pair measured being ·16 and ·17 mm., the longest ·24 and ·27 mm. The shorter spicule is more slender. Caudal alae are developed in the region of the anus and support the most posterior of the 50 or more pairs of preanal papillae. There are two pairs of large double papillae immediately postanally, and four pairs of single papillae behind these (Figure 6). Three rows of denticles lie ventrally just behind the anus.

The general appearance of the male tail strongly resembles that of *Terranova kogiae* (J. and M., 1939), but an intestinal caecum is absent. The species appears definitely to belong to *Stomachus*, most closely resembling *S. physeteris* (Baylis), from which it differs in the relative proportions of the ventriculus and oesophagus, as well as in the smaller size of both sexes.

Stomachus sp. larva.

Closely coiled larvae, enclosed in flat circular cysts and belonging to *Stomachus* (*Anisakis* of authors), have been recorded by us on several occasions (J. and M., 1943, p. 22, as *Capsularia marina* L.; 1943*a*; 1945, 98–100, 102–105 as *Stomachus marinus* L.) from a number of species of bony fish, as well as a few elasmobranchs, the worms from the latter host being considered to have been ingested along with their proper hosts and therefore not to be regarded as parasitic in sharks. We have not been able to distinguish between these larvae and no doubt most of them should be regarded as young stages of *Stomachus marinus* whose adult is a widely distributed parasite of cetaceans. Similar larvae from subantarctic fish we have assigned to *S. similis* which occurs in the elephant seals that spend part of their time ashore on subantarctic islands (J. and M., 1945, p. 105). We should mention that another species, *S. diomedeae* (Linstow), occurs in various albatrosses in the Southern Ocean (J. and M., 1942, p. 67). The sperm whale, *Physeter macrocephalus*, which is the host of *S. physeteris* (Baylis), is not sufficiently common in southern Australian waters to be considered in connection with these larvae that occur so abundantly in some of our fish, especially the barracouta, *Thyrsites atun*.

These larvae of *Stomachus* sp. are represented in the present collection by specimens from *Neoplatycephalus macrodon*, W.3549, N.S.W.; *Coelorhynchus* (*Paramacrurus*) *australis*, W.2710, from Montague Island, N.S.W., August 1929; *Neobastes scorpaenoides*, W.3547, N.S.W. without locality; *Ichthyscopus sannio*, W.3546, N.S.W. without locality; *Thyrsites atun*, W.909, Pambula, N.S.W., coll. D. G. Stead, Jan. 1903; W.3553, old coll., Wooloware Bay, N.S.W., July 1905, and W.3542, "Endeavour" coll., Investigator Strait, South Australia, August 1909; *Sciaena antarctica*, W.2772, coll. D. G. Stead, N.S.W., June 1930; ling, *Genypterus blacodes*, E.6800, "Endeavour" coll., Storm Bay, Tasmania, July 1909; "conger eel," E.6798, "Endeavour" coll., Storm Bay, Tasmania, July 1909 (A. R. McCulloch in Endeavour Fisheries Reports, Part 1, 1911, p. 18, recorded *Congermuraena habenata*, the little conger eel, as having been collected in that locality, off Port Arthur); the saw shark, *Pristis zysron*, W.2338, Manly, Sydney, Nov. 1926, and, from an unnamed fish, E.6797, "Endeavour" coll., taken off the northern Tasmanian coast between Devonport and Launceston; and also, as ingesta (W.999), from a noddy tern, *Anous minutus*, from the Great Barrier Reef. It is to be noted that Stead (1914, p. 20) recorded the presence of "immature Ascaris" from the subperitoneum of *Sciaena antarctica* from Port Kembla, N.S.W. We recorded the occurrence of the parasite (as *Capsularia marina*) in the latter host species as well as in several other South Australian fish (1943, p. 22).

In his account of *Anacanthocheilus*, Wülker (1929) reported that its larval stage occurred spirally rolled or somewhat elongate in cysts found mainly under the peritoneum of the viscera of North Sea fish, especially Gadidae. This larva was reported to have the dorsal portion of its oesophagus more or less replaced by glandular tissue. After considering the reports of Wülker and Kahl (1939), we stated (1945, p. 108) that it was probable that the larval stage of *Anacanthocheilus rotundatus* was the true *Gordius marinus* of Linnaeus.

Unfortunately we were not aware of an important paper by Punt (1941) dealing with larval and adult ascarids from the chief species of food fishes brought from the North Sea into the Belgian markets. This author referred (pp. 34–5) to the confusion which had become associated with the names *Filaria piscium*, *Ascaris capsularia*, *Filaria capsularia* and *Capsularia halecis*. He pointed out that some of these names had been applied to worms which belonged to *Anisakis* (i.e., our *Stomachus*), and that the same name had been given to larvae belonging to more than one genus. He went on to give an account of an *Anisakis* larva from *Gadus* (pp. 53–5), quoting a long list of synonyms. He pointed out that although Wülker had stated that the larva which he regarded as that of *Anacanthocheilus rotundatus* had its excretory pore at the level of the peri-oesophageal nerve ring, Wülker's figure actually showed the aperture (which he did not recognize) adjacent to the ventral perforating tooth. Punt also pointed out that the figure showed the presence of anal glands which are absent from the larva of *Eustoma* (syn. *Anacanthocheilus* Wülker), but are present in the larva of *Anisakis*. The latter larvae in their last larval moult possess well-marked lips, whereas in adult *Eustoma* these organs are only feebly indicated. Punt's view is that Wülker probably was dealing with the larva of *Anisakis* (i.e. *Stomachus*) and not that of *Eustoma*. Punt stated (p. 53) that the larvæ of *Anisakis* were slender worms, ordinarily lying coiled in a flat spiral in a cyst, with the head usually at the centre. In view of the foregoing summary we return to our earlier view that Linnaeus' *Gordius marinus* was a *Stomachus* larva whose adult stage was *Anisakis simplex* of authors, a parasite of dolphins and some other cetaceans.

Contracaecum (Thynnascaris) legendrei Dollfus.

This ascarid in its adult stage has already been recorded by us from the southern tunny (*Thunnus maccoyi*), while young stages were reported from the tiger flathead (*Neoplatycephalus macrodon*) from New South Wales (1943, p. 20), *Threpterius* and *Upeneichthys* from South Australia (1944, p. 61), *Caranx georgianus*, *Platycephalus bassensis*, *P. fuscus* and *P. laevigatus* from the Derwent River, Tasmania, and *Upeneichthys porosus* from south Western Australia (1945, p. 133).

In the present collection are two very poorly preserved worms which we regard as belonging to this species. The host is the Queensland groper, *Promicrops lanceolatus*, W.3560, from Hummocky Island, Keppel Bay, " Endeavour " coll., July 1910.

Contracaecum (Thynnascaris) aduncum (Rud.).

This parasite is recorded for the first time as occurring in Australian fish, the present collection containing specimens from the trevally, *Caranx georgianus*, W.18, from Flinders Island, Bass Strait, and E.693, " Endeavour " coll., May 1909; *Zeus faber*, E.5434, " Endeavour " coll., May 1914, from 70 fathoms off Tathra Head, N.S.W.; and from an unnamed fish, W.3548, " Endeavour " coll., June 1909, from 20 fathoms, off the mouth of the Murray River, South Australia; as well as from *Gadus morrhua*, W.3541, not an Australian collection.

An excellent account of this common parasite of Gadidae in the North Sea was given by Punt (1941, pp. 8–37, Figures 1–27). Amongst the synonyms he included *? Ascaris gadi* Muller 1786. We (1945, p. 132) considered the correct name of the species to be *C.* (*Thynnascaris*) *gadi* (Muller). Punt pointed out that the adult stage occurred especially in Gadidae and that the larger species (*Gadus morrhua* and *G. virens*) had a percentage infection of nearly 100%, while in smaller species it ranged from 25 to about 90%, probably associated with the different food habits of the smallest species where 25–45% were infected. The parasite was found in some other North Sea fish. A list of those species in which he found larval or adult stages was published (pp. 88–101)

Contracaecum (Thynnascaris), sp.

From a flathead, *Platycephalus bassensis*, E.6799, Oyster Bay, Tasmania. " Endeavour" coll., July 1909.

ASCARINAE.

Ophidascaris filaria (Duj.).

This large species is represented in the present collection from New South Wales snakes; *P. spilotes spilotes* (diamond snake of the Sydney district), W.3538, old collection, June 1890, and W.3552, " diamond snake "; as well as from *P. spilotes variegata* (carpet snake), W.3244, W.3562, W.3545, and W.3536. It had been recorded previously by Baylis (1920, p. 414) from *P. spilotes* from " Australia "; and by us (1948, p. 104) from south-eastern Queensland.

Krefft (1871, p. 214) reported the presence of *Ascaris* sp. from *Morelia spilotes* and *M. variegata*. One of us (Johnston, 1911, pp. 234, 235) recorded that a large *Ascaris* sp. occurred rather commonly in *Python variegatus* and *P. spilotes* in New South Wales and Queensland. Some of the Museum material examined by us was probably collected by Krefft, because some of the hosts were indicated as *Morelia spilotes* and *M.s. variegata*. *Ascaris* sp. of the two authors mentioned is a synonym of *Ophidascaris filaria* and *Polydelphis anoura*.

Polydelphis anoura (Duj.).

This ascarid was identified from *Python spilotes variegatus*, W.326 and W.327, N.S.W. It had been recorded previously by us (1948, p. 104) from this host species from New South Wales and Queensland.

Polydelphis sp.

Females of a species of the genus were found in a "sea snake", W.3556, old collection, presumably from New South Wales.

SPIRURATA.

PHYSALOPTERIDAE.

Physaloptera confusa (J. and M.).

This common parasite of the stomach of Australian venomous snakes was present in several collections: *Pseudechis porphyriacus*, W.322, W.3544, N.S.W.; W.3558, Moore Park, Sydney; G.1234, Tenterfield, N.S.W., coll. C. A. Lee; and a female, W.3543, probably belongs to the same species; *Notechis scutatus*, W.921, Randwick, Sydney; *Denisonia suta*, W.3535, Narrabri, N.S.W. The last-named host was indicated as "*D. frontalis* (black snake)". Mr. F. J. Mitchell, of the South Australian Museum, has been kind enough to assist us in regard to the name. Ogilby in 1889 described the species as *Hoplocephalus frontalis* from a specimen from Narrabri; Boulenger (*Cat. Snakes, Brit. Mus.*, 1896, p. 340) transferred it to *Denisonia*; and Kinghorn (REC. AUSTR. MUS., 13 (3), 1920, p. 110) placed the species as a synonym of *D. suta* (Peters, 1863) Boulenger, 1896. As the parasite belonged to the old collection it probably came from Ogilby's snake, hence the locality, Narrabri, assigned to it by us.

P. confusa was also identified (W.891) from a "large snake" taken at Immarna, East-West Railway, near Ooldea, South Australia. Mr. Kinghorn has informed us that two species of snakes, *Demansia psammophis* and *Pseudechis australis*, were obtained at that locality. The use of the term "large snake" by the collector indicates *Pseudechis australis* rather than the other species as the host from which these nematodes were taken.

P. confusa was recorded by us from *Notechis scutatus* in South Australia (1942, p. 90), *Pseudechis porphyriacus* and various other snakes from Queensland and N.S.W. (1948, p. 106), as well as from *Varanus* sp. (1947, p. 24).

Physaloptera antarctica Linstow (emend. Irwin-Smith).

The collection contains specimens from the stomach of *Varanus varius*, W.3556, old coll., N.S.W., Sept. 1895; and *V. gouldi*, W.1066 and W.1071, both from Mt. Lyndhurst, near Farina, South Australia. We have already recorded it from *V. varius* from Kangaroo Island (1942, p. 91) and Queensland (1947, p. 24).

Physaloptera sp. (larvae).

Some larval cysts were identified from *Python spilotes variegatus*, W.3537, N.S.W., old collection. They probably belong to *P. confusa* whose larval stage we have recorded (1942, p. 91) from frogs from New South Wales and South Australia.

Paraleptus australis J. and M.

Two poorly preserved worms from *Heterodontus portusjacksoni*, W.2576, collected by Capt. K. Moeller, N.S.W. coast, December 1928, are referred to *Paraleptus australis*, which is a common species in this host (J. and M., 1943, p. 188).

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THE NEW SOUTH WALES PYRAMIDELLIDAE AND THE GENUS *MATHILDA*.

By Charles F. Laseron, F.R.Z.S.
Honorary Correspondent, Australian Museum.

(Figures 1–98.)

INTRODUCTION.

This paper is intended primarily as an illustrated check-list of the species of Pyramidellidae of the Neoperonian Zoogeographical Province, and it includes mainly gasteropods with heterotrophe protoconchs. This widens the family limits as dealt with in Hedley's Check List (1917), but in addition to affording a more convenient classification, it is in general keeping with present-day opinion abroad. Opinions as to the phylogenetic value of the protoconch may differ, but in some families it is of undoubted importance. Here, at least, it affords a very definite character which, in the absence of any knowledge of anatomy and life history, links a number of shells with many other characters in common.

The family is old geologically and has a world-wide range, and the list of known species is great and continually growing. Of late years some detailed research on the animal and its life history has been done in Europe and America, but in Australia the systematist still holds the field. Here the immediate necessity is to determine and list the numerous species, so that deeper research may begin. In New South Wales the only knowledge of the animal so far is the description and figure of *Linopyrga pascoei* by Charles Hedley (1916). Hedley points out that this agrees very well with the animal of the other species of the family, as known elsewhere. Anatomically, the absence of a radula is held as a family characteristic, as is the presence of a horny, pauci-spiral operculum, notched to conform with the columella fold, and with the nucleus sub-marginal and anterior.

THE HETEROTROPHE PROTOCONCH.

This type of protoconch is very distinctive and varies little right throughout the family. Its peculiar form depends on the fact that in its larval state the animal is sinistral while in the adult stage it is dextral. The actual change takes place within and before the close of the larval period; it may be comparatively rapid or more or less prolonged, and there is nearly always a stage during which the symmetry of the animal is balanced and the resultant shell is in the form of a straight tube. It is these factors which make slight differences in the apices of the different species.

Typically the extreme nucleus is sinistral, consisting of generally two, but sometimes three or even four helicoid whorls, the first minute, the second inflated. When the change to the dextral form is rapid the whorl bends right back on itself and, still in the larval stage, encloses or passes below the apex in half or even a complex dextral whorl. At the close of the larval stage there is a pause, and the protoconch may be separated from the first adult whorl by a distinct varix which is, however, rarely visible. The angle the first dextral turn makes with the sinistral nucleus has a varying effect. In some species the nucleus is so enfolded as to be quite invisible; in many of the Turbonillas it lies recumbent on the peak of the adult shell. In the Eulimellas, particularly, the neutral stage, that is between sinistral and dextral, is so prolonged that the whole protoconch is extended, or lies at an angle with the axis of the mature shell. Figures 95–98 show protoconchs of four species of different genera, and illustrate variations in the coiling.

An important aspect of the heterotrophe protoconch is that recent research suggests that it shows a free-swimming larval stage. Larval sinistral shells have been found in numbers in plankton in European waters, and have been dealt with comprehensively by the Danish zoologist Gunnar Thorson (1946). He has identified these with local species of Pyramidellidae, and holds the view that the sinistral types are free-swimming and that certain other dextral forms are not so. No dextral protoconch has so far been identified with certainty in any New South Wales species of this group, but the development of a varix is a common feature of larvae at the end of their free-swimming existence, and bears out Thorson's views. Further evidence can be found in their distribution, for they have been recorded from many of the Pacific oceanic islands. In these locations the marine fauna is invariably ill-balanced, consisting entirely of creatures capable, either in a larval or adult state, of traversing the intervening oceans.

HABITAT.

There is little information on this point. Very few of the local species have been taken alive, but their occurrence suggests that while some live in sand, the majority prefer a muddy or sand-mud bottom. Some definitely live on algae, and *Chemnitzia hofmani* is almost invariably so found, sometimes in such numbers as to be considered gregarious. *Linopyrga pascoei* is abundant under rocks in pools between tide marks, and we have found *Odostomia indistincta* in a large colony in galeolaria tubes between tide marks in Port Jackson. Most of our material, however, comes from beaches or from dredging and has been dead when obtained. Species occur from above low tide to very deep water, in at least 800 fathoms, and well beyond the continental shelf. There is no evidence of food, but in the absence of a radula, it is probable that they live on microscopic floating life, or on the organic material present in mud or sand.

THE GENERA OF PYRAMIDELLIDAE.

It has already been stated that the limits of the family as here dealt with are wider than that allowed in Hedley's Check List. Hedley included *Cingulina* and *Mathilda* in the Acteonidae, and *Eulimella* and *Pseudorissoina* in the Eulimidae. In the absence of knowledge of the animals of Australian shells, and working on shell characters alone, these genera, with the possible exception of *Mathilda*, have far more in common with the Pyramidellids than with either *Acteon* or *Eulima*. The heterotrophe protoconch has been taken as the main determining character, but there is abundant support for such a course in the opinions of most oversea conchologists.

The position of *Mathilda* is uncertain. The genotype is a European fossil, and nothing is known of the animal of the few living species. The protoconch is eccentric, but it is doubtful if the nucleus is sinistral, therefore it is not heterotrophe, thus differing from most of the true Pyramidellidae. On the other hand, in shell characters, it has much more in common with this family than with *Eulima* and its allies. Quite probably it should be considered a distinct family. Hence it has been thought better to consider it separately, and it is discussed in a section by itself at the end of this paper.

The basis of the modern classification of the Pyramidellidae was, until recently, a paper by W. H. Dall and P. Bartsch, published in 1904. Thiele (1931), generally accepted as the standard text-book on molluscan classification, follows Dall and Bartsch almost in entirety. Of the four genera mentioned above, Dall and Bartsch place *Eulimella* as a subgenus of *Pyramidella*, *Cingulina* as a subgenus of *Turbonilla*, and *Pseudorissoina* as a subgenus of *Odostomia*. *Mathilda* is not mentioned.

For the whole of the family they allowed but four genera, *Pyramidella* Lamarck, *Turbonilla* Russo, *Odostomia* Fleming, and *Murchisonella* Morch. These were divided into many subgenera and sections, using a selection of the many generic names introduced by various writers during the last hundred years. The paper is of the greatest value, but its main weakness is that it is too rigid and artificial to meet the requirements of conchologists working in detail in particular regions, and it contains some obvious anomalies. Another objection is that its adoption would lead to too great a departure from accepted binomial nomenclature. The use of generic, subgeneric and sectional, as well as specific and sometimes subspecific names, would necessitate the application of as many as five names for the one form, which is not only cumbersome but quite outside accepted practice.

In later years the most valuable contribution to the taxonomy of the family has been made by Dr. C. R. Laws, of Auckland, New Zealand. In a series of papers on the "Tertiary and Recent Neozelandic Pyramidellids" (1937–41), he has reviewed the nomenclature of the whole group and brought it into line with the Linnean system. Most of Dall and Bartsch's subgenera were restored to generic rank and others were proposed for Neozelandic forms. The addition of practical keys makes the work of great value to students.

The present paper had been practically completed before I had the opportunity of studying Dr. Laws' work, which was perhaps fortunate, for it meant a quite independent approach to the subject. It is interesting to note that the conclusions arrived at were essentially the same, and that the same interpretation was given to such names as *Agatha*, *Scalenostoma*, *Elodiamea*, *Pyrgulina*, *Miralda* and others. There are naturally differences, as the Neoperonian has a somewhat different facies from the Neozelandic fauna, but on the whole it is hoped that the papers will tie together satisfactorily as a basis for future work.

ACKNOWLEDGMENTS.

In the preparation of this paper my thanks are particularly due to Miss Joyce Allan, Conchologist to the Australian Museum, who has not only located many references for me, but has helped with suggestions and also read and checked the manuscript. To many members of the Marine Section of the Royal Zoological Society I am also indebted for supplementing the material collected by myself and my son, Mr. John Laseron. To the latter must go much of the credit in the detection of many of the new species, particularly those of minute size.

TYPES.

All species illustrated, as well as the types, have been presented to the Australian Museum, where they will be available for future reference.

DESCRIPTION OF SPECIES.

Reference :

"Hedley, 1026." Number in Hedley's Check List of Marine Mollusca of New South Wales. Supplement to Jour. Royal Soc. N.S.W., Vol. li. 1917.

"May, 959." Number in May's Check List of the Mollusca of Tasmania. Govt. Printer, Hobart, 1921.

Genus **Syrnola** Adams.

Typically elongated shells with flattened whorls, smooth and porcellanous in texture, often coloured or with brown bands, the protoconch exsert and tilted, heterotrophe, the columella fold single, generally prominent, but occasionally nearly obsolete and only visible inside the aperture.

Dall and Bartsch placed it as a subgenus of *Pyramidella*, an obvious anomaly, as the single columella fold at once removes it from that genus, or rather group of genera. Laws divided the Neozelandic Syrnolas into five genera, two of which, *Tibersyrnola*, with lirations within the outer lip, and *Costosyrnola* with axial ribs, have no Neoperonian parallels. Nor do the Neoperonian species altogether fit his key for the other three genera, except perhaps for *Puposyrnola*. This is here used for the new species *proletare*, and would also include the Tasmanian species *harrissoni* and *petterdi*, 957 and 958 on May's list. A more natural grouping of the local species would be by shell texture, dividing those with porcellanous shells, coloured or with bands, from those like *manifesta* which have translucent colourless shells with longer body whorls. The former group also fall into two groups, those with a prominent columella fold like *bifasciata*, *lata* and *jacksonensis*, and those with feeble folds like *tincta* and *aurantiaca*. In what might be called the *manifesta* group of species there seems a gradual transition to shorter shells, merging into *Puposyrnola*, *Agatha* and *Odostomia*. *Syrnola* is here retained in rather a wider sense than used by Laws, the alternative being the proposal of several new genera.

Syrnola tincta Angas.

(Figures 1, 2.)

Hedley 1026; May 959.

This is one of the common species on our coast, and is found mainly on the beaches, both inside and outside the harbours. The specimens figured are from Manly Ocean Beach, Figure 1, 5·8 mm. in length, and Figure 2, 5·2 mm. in length. We also have it from Point Halliday on the North Coast, from Jervis Bay, and it extends to Tasmania. It is rather variable in width, the two figures representing about the extremes. The colour is uniformly yellow, the columella fold nearly obsolete and only visible within the aperture.

Syrnola aurantiaca Angas.

(Figure 4.)

Hedley 1022.

The figure is not quite typical, being larger than the type, which is 6 mm. long with 8 whorls. The figured specimen is 9·5 mm. with 10 whorls, and was dredged in 15 fathoms, Jervis Bay. It is probably an old and exceptionally large specimen, agreeing otherwise with Angas's description. As this is not readily available these points may be noted: "Colour fulvous yellow, with a pale band below the suture, the sutures not impressed, the columella nearly straight, the fold small and indistinct." The type locality is deep water, Port Jackson.

Since the above was written specimens have come to hand from 6-8 fathoms Pittwater, Broken Bay. These are quite typical.

The rudimentary fold connects this with *S. tincta*, but the species is generally larger and wider, and the inner margin of the aperture is more strongly reflected. The fold, practically invisible from in front, is visible within the aperture.

Syrnola bifasciata Ten.-Woods.

(Figure 8.)

Hedley 1023.

Colour variable, beach specimens generally white, but when fresh it is yellow with two orange bands. Common in many localities, the figured specimen is from reclamations in Botany Bay, and is 8 mm. in length. This is exceptionally large for the species. We also have it from Pittwater, and from Jervis Bay from the beach down to 5 fathoms. The species is much broader than *tincta*, the columella is broad and straight and strongly reflected, and the fold is very prominent.

Syrnola lata, sp. nov.

(Figure 3.)

Shell of medium size, broadly conical, white with traces of brown bands. Protoconch heterotrophe, prominent. Mature whorls 6, increasing regularly, nearly flat, sutures barely indented, body whorl large. Aperture pyriform, produced anteriorly, outer margin thickened, interior margin widely reflected. Columella fold very strong, oblique. Length, 4·5 mm.; width, 1·8 mm.

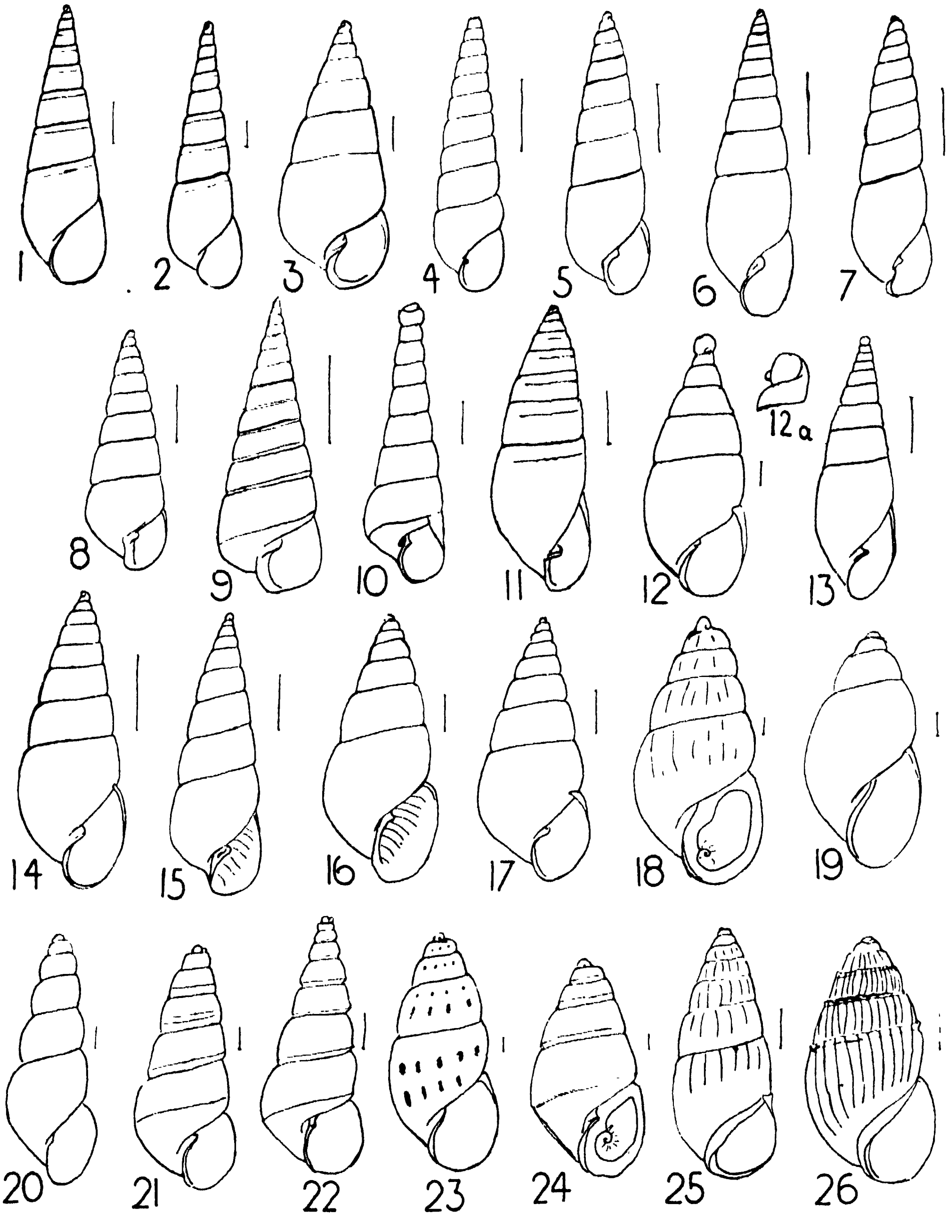
Localities.—On beach, Huskisson, Jervis Bay (type); also 6–8 fathoms, Pittwater.

Remarks.—I am not sure if the type is quite mature, but the great width relative to the length separates it from *S. bifasciata*, the species which it most closely resembles.

Syrnola jacksonensis, sp. nov.

(Figure 5.)

Shell large for the genus, elongately conical, the early whorls increasing slightly more rapidly than the later, giving the shell a slightly curved contour, colour white with a yellow band on the periphery of the body whorl and immediately above the suture on the earlier



Figures 1-26.

1, *Syrnola tincta* Adams. 2, *S. tincta* Adams (broad variety). 3, *S. lata* Laseron. 4, *S. aurantiaca* Angas 5, *S. jacksonensis* Laseron. 6, *S. manifesta* Hedley. 7, *S. angusta* Laseron. 8, *S. bifasciata* Ten.-Wood. 9, *S.* (*Colyrsyrnola*) *decolorata* Iredale. 10, *S. macrocephala* Hedley. 11, *S. convexa* Laseron. 12, *Puposyrnola tasmanica* Ten.-Woods. 13, *P. proletare* Laseron. 14, *Agatha australis* Angas. 15, *A. laevis* Angas. 16, *A. simplex* Angas. 17, *A. angasi* Tryon. 18, *Odostomia indistincta* Brazier. 19, *O. occultidens* May. 20, *O. stricta* Laseron. 21, *Scalenostoma subcarina* Laseron. 22, *S. ? subcarina* Laseron. 23, *Odostomia leopardis* Laseron 24, *Scalenostoma pyramidata* Laseron. 25, *Rugadentia ignara* Hedley. 26, *R. doliae* Laseron.

whorls. Protoconch typically heterotrophe, two-whorled, the first minute, the second inflated. Mature whorls eight, nearly flat, sutures slightly impressed. Sculpture none, the surface smooth, polished and shining. Aperture short, produced anteriorly, outer margin simple, rounded, inner margin curved and reflected. Columella fold large and prominent. Length, 9 mm.

Locality.—Dredged in 15 fathoms between Heads, Port Jackson, eight specimens.

Remarks.—This species is related to *S. bifasciata*, but is much larger, narrower, and the inner margin of the aperture is curved and is not so greatly reflected. From *S. manifesta* it differs in shape and colour, the body whorl is not so long and the aperture is different.

Syrnola manifesta Hedley.

(Figure 6.)

Hedley 1025.

The type locality is Port Stephens, and it is also recorded from the far North Coast. We have a number of specimens dredged in Port Jackson from North Harbour across to Sow and Pigs Reef. They agree very well with the type. The specimen figured is 11 mm. in length. The species may be recognized by the white, smooth shell, without coloured bands, by its regular tapering form, pyriform aperture, strong columella fold, and the elongated body whorl.

Syrnola angusta, sp. nov.

(Figure 7.)

Shell of moderate size, elongated, white, shining, translucent. Protoconch typically heterotrophe, slightly tilted. Mature whorls eight, increasing more rapidly at first, making the contour of the top of the spire slightly convex. Whorls flattened, sutures not indented, body whorl comparatively long. Aperture narrowly pyriform, extended anteriorly, acutely angled posteriorly, outer margin thin, curved, inner margin strongly curved back and slightly reflected, columella fold strong, oblique. Length, 9 mm.

Locality.—Shellharbour (type); Cronulla (coll. by Mrs. F. Kay).

Remarks.—The type was separated from *S. manifesta*, and was thought at first to be a variety of that species, but further specimens from Cronulla, where it is not uncommon, show that the differences are constant, and that it is a good species. Compared with *S. manifesta*, it is slightly smaller, narrower, the spire has a different contour, and it differs in details of the aperture. With *S. manifesta* and the next species, *S. convexa*, it forms a small natural group, progressingly approaching such species as *petterdi* and *tasmanica*, and linking *Syrnola* with *Odostomia*.

Syrnola convexa, sp. nov.

(Figures 11, 95.)

Shell of medium size, comparatively stout, spire convex, white, shining and translucent. Protoconch small, heterotrophe, slightly tilted, the minute sinistral apex nearly reversed. Mature whorls seven, increasing at first much more rapidly, making the spire strongly convex. Whorls flattened, slightly stepped, sutures hardly indented, body whorl long. Aperture pyriform, long and narrow, extended anteriorly, sharply angled posteriorly, outer margin thin and rounded, inner margin short, nearly straight, and strongly reflected. Columella fold large, prominent and nearly transverse. Length, 7·6 mm.

Locality.—Cronulla (type), not uncommon (collected by Mrs. F. Kay); also Port Stephens and Shellharbour.

Remarks.—Allied to *S. manifesta* and *S. angusta*, it differs from both by being smaller, much broader, and by the strong convexity of the spire, the latter being a particularly good recognition point. The aperture is also narrower, and the strong reflection of the inner margin also separates it. It is also allied to *S. petterdi*, a Tasmanian species, and before mature specimens came to hand, was tentatively referred to that species. Specimens from Shellharbour, which are apparently immature, are relatively narrower, and there seems to be some variation in this character.

Syrnola macrocephala Hedley.

(Figure 10, after Hedley.)

Hedley 1024.

This curious shell is retained in *Syrnola*, though its characters suggest that it would be better relegated to a new genus. The only known specimen came from 63–75 fathoms off Port Kembla, its dimensions 6 × 1·5 mm. The large tumid protoconch and expanded base should prove ready recognition features.

Genus **Colsyrnola** Iredale.

Genotype, *Colsyrnola sericea* Iredale, *Australian Zoologist*, 1929, Vol. v, Pt. iv, p. 348, Pl. xxxviii, Figure 16.

Iredale designates no characters for his genus, beyond comparing it with the Japanese shell *Obeliscus brunneus*. To clear the matter for Australian conchologists, it can be stated that *Colsyrnola* has the same general characters as *Syrnola*, but is much larger, the whorls are more numerous and relatively much shorter.

Colsyrnola sericea Iredale.

The type of this species came from dredgings by the " Triton " in the East Channel, Sow and Pigs Reef, Port Jackson, and was 26 mm. in length. Iredale also gives the locality of the species as North Queensland. This with other tropical shells came from a bed of sand some 30 feet below the harbour bed, and though some of these have since been rediscovered on the continental shelf, it is possible that others are extinct. Though specimens have retained their gloss and are in excellent condition, the colour has generally altered to some shade of yellow or orange, and has little value for specific determination. Thus the type of this species is given as orange-brown, that of the North Queensland shell as deep red-brown, which is probably the true colour.

Colsyrnola decolorata Iredale.

(Figure 9.)

Records of Australian Museum, xix, 1936, p. 330, Pl. xxiv, Figure 14.

This species is confined to deep water, and is an inhabitant of the continental shelf. The specimen figured is from 25–30 fathoms, Shoalhaven Bight, and is 16 mm. in length. Apart from the generic characters of the numerous short whorls and the large size, the narrow yellow band is a good recognition point.

Genus **Puposyrnola** Laws, 1937.

Under *Puposyrnola* come shells which are intermediate between *Syrnola* and the Odostomids. The main characters are long body whorl, a pupoid shape, the contour being distinctly convex, while the aperture is restricted anteriorly, giving a distinct facies. *P. proletare* may be considered typical, while *Syrnola convexa* is on the borderline, linking *Puposyrnola* with the *manifesta* group of *Syrnola*. The Tasmanian species *harrissoni* and *petterdi* come here. Another Tasmanian species *tasmanica* is also doubtfully included, as the inflated protoconch and weak columella plait suggest different relationship.

Puposyrnola proletare, sp. nov.

(Figure 13.)

Shell of medium size, elongate, conical, uniformly white and translucent. Protoconch typically heterotrophe, two-whorled, the first minute, the second inflated, somewhat flattened, the whole rather less than the apex of the main shell. Mature whorls eight, increasing rapidly, narrow, the body whorl elongated, nearly half the total length of the shell. Whorls very slightly rounded, sutures moderately impressed, smooth and shining, the only sculpture a few faint growth lines. Aperture pyriform, elongated, acutely angled posteriorly, produced and rounded anteriorly, outer margin simple and rounded, inner margin rounded and very slightly reflected. Columella fold large and nearly transverse, no umbilical furrow. Length, 7·5 mm.

Locality.—30–35 fathoms off Crookhaven.

Remarks.—This is related to *P. petterdi*, *tasmanica* and *harrissoni*, but differs from these species in being much narrower, and also in the proportion of the body whorl to the whole length, which gives it a different facies.

Puposyrnola tasmanica Ten.-Woods.

(Figure 12.)

May 958 (*Syrnola*).

Two specimens, sorted from dredgings, 15 fathoms, off the Clarence River, are rather doubtfully referred to this species. This is an addition to the New South Wales fauna. Further material may show, however, that it is an undescribed species. Characteristics are the rapid increase in the size of the whorls, and the large inflated protoconch. The length of the specimen figured is 3 mm.

May placed this species in *Syrnola*, and it is difficult to say just where *Syrnola* ends and *Odostomia* begins. The uncoloured Syrnolas such as *S. manifesta* merge through *S. convexa* into shorter spired shells such as *Puposyrnola petterdi*, this species and *P. proletare*.

Genus **Agatha** A. Adams, 1860.

Under *Agatha* come many species which have been listed in Australia as *Odostomia*. The Neoperonian species greatly resemble the Neozelandic forms both fossil and recent. Laws (1940) gives as the generic features of *Agatha* : " Large size, high body-whorl with elongated, subovate aperture, oblique, arcuate pillar with a strong plait entering aperture spirally at a high angle " ; and there is also a slight umbilical chink. The strong reflection of the inner margin also gives a distinct facies. The protoconch is small, exsert, and typically heterotrophe.

Agatha australis Angas.

(Figure 14.)

Hedley 1030.

This, a well-defined species, is common on the beaches and in shallow-water dredgings on many parts of the coast. The specimen figured is from 6–9 fathoms, Sow and Pigs Reef, Port Jackson, and is 10 mm. in length. We also have it from Port Stephens, Pittwater and elsewhere.

Around *A. australis* centre a group of species with very similar facies, with smooth, white, glossy shells, pyriform apertures, generally wider and shorter than in the preceding group, and with the body whorl also much shorter. The whorls increase more regularly, and the shell contour is therefore straighter. The columella fold is prominent. In some ways it links with *Syrnola* through *S. manifesta*. With it may be grouped *O. laevis*, *O. simplex* and *O. angasi*.

Agatha laevis Angas.

(Figure 15.)

Hedley 1034.

Very similar to *O. australis*, but it is smaller and narrower. The aperture is sometimes faintly lirate within. The type locality is " deep water " Port Jackson, and the specimen figured comes from 6–9 fathoms, Sow and Pigs Reef, and is 7·6 mm. in length. We also have it from the beach at Shellharbour.

Agatha simplex Angas.

(Figure 16.)

Hedley 1039.

This is another species of the same group, but it is still smaller and correspondingly broader than either *O. australis* or *O. laevis*. A characteristic feature is that it is strongly lirate within the aperture. It was dredged abundantly in from 4 to 6 fathoms, North Harbour, Port Jackson, the specimen figured 5·2 mm. in length. Specimens from 6–9 fathoms, Sow and Pigs Reef, have the outer margin of the aperture much thickened, though this character is variable, apparently due to the age of the individual.

Laws (1940) considers that lirations within the aperture are of generic value and proposes the genus *Evelynella* for New Zealand species with this character. This course is not followed here as in *A. laevis* the lirations are very faint, and by retaining both *simplex* and *laevis* in *Agatha* the grouping is much more natural.

Agatha angasi Tryon.

(Figure 17.)

Hedley 1029.

This species, under which Hedley synonymized *O. lactea* of Angas, has been rather doubtfully identified. After comparison with specimens in the Australian Museum, specimens from 15 fathoms Jervis Bay have been taken as *A. angasi*, that figured being 6 mm. long. These are nearly identical with *A. simplex*, but there is no liration within the aperture, a character which may be taken as distinctive. For purposes of reference, Angas's description (1867) of *O. lactea* is here repeated : " Shell elongate, rather thin, smooth, white, shining; whorls six, flattened, sutures impressed, aperture small, ovate, somewhat produced anteriorly, one-third the length of the shell; columella fold strong and a little oblique; outer lip thin, simple. Length 3 lines, breadth 1 line."

Genus **Odostomia** Fleming, 1813.

Considerable difference in opinion exists as to the exact limitations of Fleming's genus. Dall and Bartsch used it as a subgenus as well as in the broader generic sense, in which they included all sculptured shells as well. Hedley used it in the wider sense also, only separating from it his own genus *Myxa*. In Dall and Bartsch, the subgenus *Odostomia* was restricted to smooth shells which were not inflated. For shells with inflated body whorls they used *Amaura* Moller, 1842. For rather similar shells from New Zealand Laws uses *Gumina* Finlay, 1928.

He also states (1939) : " Odostomia in the strict sense has the following characters—Spire not greatly elevated, few whorls, and a single columella fold. Surface typically smooth. Strong, universal, spiral sculpture is absent. Protoconch low, considerably immersed and thus contrasting with that of the Turbonillids and Syrnolids." Without proposing new genera, he also divides the New Zealand Odostomias into two groups, A and B, the first with the nucleus evident and helicoid, the second with the nucleus not projecting.

Of the Neoperonian species, *indistincta* agrees very well with the above limitation, *occultidens*, *tumerea* and *leopardis* not so well, while *microlinea* and *stricta* are rather too elongated to fit. One feature all these species have in common is the weak columella fold, and most of them have the protoconch wholly or partially immersed.

Odostomia indistincta Brazier.

(Figure 18.)

Hedley 1033.

This is the smallest of the group, the specimen figured being 2 mm. in length. It is not uncommon on the beaches, but we found it alive abundantly in galeolaria tubes between tide marks in North Harbour, Port Jackson. It is abundant also at Angowrie, just south of the Clarence River. Characteristics, apart from size, are the thin, transparent shell, the very small protoconch, occupying only about half of the summit of the shell, and the slight columella fold. The operculum is pauci-spiral, notched on the inner margin, the nucleus anterior, small but distinct, surrounded by short, strong growth lines, leaving the remainder of the surface smooth.

Odostomia microlinea, sp. nov.

(Figure 47.)

Shell small, cylindro-conical, white, shining. Protoconch probably heterotrophe, infolded. Mature whorls four, increasing regularly, slightly rounded, sutures slightly indented. Sculpture under moderate magnification invisible, but under the microscope numerous well-defined but irregular growth lines can be seen. Aperture ovate, well extended anteriorly, elongated, thin, outer and anterior margins rounded, inner margin not reflected. Columella fold very slight. Length, 2·4 mm.

Locality.—6–9 fathoms, Sow and Pigs Reef (type); also 14 fathoms off Long Reef.

Remarks.— This species comes very close to *O. indistincta*, which has the same type of protoconch, the same nearly obsolete fold and the same microscopic growth lines, but it differs by being much narrower, and with a whiter, less translucent shell.

Odostomia tumerea, sp. nov.

(Figure 45.)

Shell minute, broadly conical, white, shining and subtranslucent. Protoconch just visible above the apex in which it is infolded. Mature whorls three, rounded, constricted at the sutures, increasing rapidly, body whorls large and inflated. At the sutures is a narrow but distinct shelf. Practically smooth, the only sculpture consists of microscopic growth lines. Aperture sub-circular, thickened, extended anteriorly, outer margin rounded, inner margin reflected, standing out from the body whorl, producing a deep, umbilical slit. Columella fold small but distinct. Length, 1·3 mm.

Locality.—Shell sand, Gunnamatta Bay, Port Hacking (three specimens).

Remarks.—Though with only three whorls, I think the type is mature, as the aperture is so well developed. The general form, large body whorl, infolded protoconch and rounded aperture are good recognition points. It comes nearer to *O. indistincta* than to any other species.

Odostomia occultidens May.

(Figure 19.)

May 965.

Several specimens dredged in Quarantine Bay, Port Jackson, agree very well with May's species, which is a new record for New South Wales. The specimen figured is 3 mm. in length. Characteristics are the large and inflated body whorl, and the small columella fold invisible from in front.

Odostomia stricta, sp. nov.

(Figure 20.)

Shell of medium size, elongate, cylindrical, rather thin, colourless and translucent. Protoconch heterotrophe, small, nearly submerged. Mature whorls five, increasing regularly, rounded, constricted at the sutures. The surface smooth and polished without sculpture. Aperture ovate, extended anteriorly and rounded, outer margin rounded and simple, inner margin very slightly reflected. Columella fold slight but distinct, nearly invisible from in front. Length, 3·2 mm.

Locality.—Port Stephens in shell sand, five specimens, including the type; also Cronulla.

Remarks.—But for the slight but distinct columella fold, this might be placed in *Eulimella*, and its form may generally be compared with *E. moniliforme*. I know of no other *Odostomia* with which it can be compared. The elongate shell is a characteristic eature.

Odostomia leopardis, sp. nov.

(Figure 23.)

Shell minute, cylindrical, yellow-brown with two rows of vertically oblong, chestnut patches, fading on old specimens. Protoconch heterotrophe, relatively small, about half the width of the first mature whorl. Mature whorls four, increasing regularly, slightly rounded, sutures impressed. Surface smooth and polished, the only sculpture microscopic growth lines. Aperture ovate, produced anteriorly, outer margin simple, rounded, inner margin very slightly reflected. Columella fold slight but distinct. Operculum too far retracted for proper description, but thin with the nucleus anterior and covered with faint growth lines. Length, 1·8 mm.

Habitat.—Alive on sea-weed, 4 fathoms off Woollahra Point, Port Jackson; also two specimens dredged 6–9 fathoms, Sow and Pigs Reef.

Remarks.—The general form is unlike that of any other Australian *Odostomia*, and the distinctive colouring is a good recognition mark.

Genus **Scalenostoma** Deshayes, 1863.

Shells related to *Odostomia*, smooth and polished, but with a peripheral keel. The columella fold is prominent.

Scalenostoma subcarina, sp. nov.

(Figure 21.)

Shell elongated conical, colourless, polished and sub-translucent. Protoconch small heterotrophe, two-whorled, partially submerged. Mature whorls five, increasing regularly, slightly rounded, with a slight but distinct angulation above the sutures and on the periphery of the body whorl; sutures impressed. There is no sculpture and the surface is smooth and shining. Aperture ovate, produced anteriorly, outer margin simple, rounded, inner margin curved, slightly reflected. Columella fold prominent, nearly transverse. Length, 3 mm.

Locality.—6–9 fathoms, Sow and Pigs Reef, Port Jackson, abundant.

Remarks.—The slight but distinct angulation brings it within *Scalenostoma* as distinct from *Odostomia*, and there is none of the local species in this group with which it can be compared. Its nearest known ally is apparently *S. southlandica* Laws, an Oligocene fossil, from New Zealand.

Scalenostoma subcarina (?) Laseron.

(Figure 22.)

A single specimen from the Ocean Beach, Manly, more than 5 mm. in length, is probably an undescribed species, but is so close to *S. subcarina* that it may possibly be a giant specimen of that species with two extra whorls. Hence more material is needed before this question can be satisfactorily settled. There is no reason to doubt, however, that the type of *S. subcarina* is mature, for it was found in quantity, and of a uniform size, all about 3 mm. in length, and these specimens were slightly less angular than the doubtful one here figured.

Scalenostoma pyramidata, sp. nov.

(Figure 24.)

Shell small, pyramidal, colourless, polished and translucent. Protoconch relatively small, heterotrophe, half submerged. Mature whorls four, expanding regularly, flattened with a sharp and distinct keel above the sutures and on the periphery of the body whorl. Sutures channelled. There is no sculpture and the surface is smooth. Aperture oval, produced and expanded anteriorly, outer margin simple, inner margin moderately reflected, columella fold prominent, slightly oblique, umbilical slit narrow but distinct. Operculum sulcus on inner margin, nucleus anterior but sub-central, prominent, surrounded with short growth lines, outer portion smooth. Length, 2·2 mm.

Habitat.—Living on seaweed, 4 fathoms, Woollahra Point, Port Jackson, five specimens.

Remarks.—It is possible that the type is not quite mature, but its characters are so distinctive that the addition of another whorl is not likely to affect its future recognition. It is very different in form and other details from the other species of *Scalenostoma* here described.

Genus **Rugadentia**, gen. nov.

Genotype, *Odostomia ignava* Hedley.

Tumid shells related to *Odostomia*, white, solid and translucent, cylindroconic, aperture comparatively small and pyriform, the inner margin with a broad band of callus, the columella fold reduced to a slight, narrow plication. Sculpture consisting of irregular, rounded, transverse ribs, more prominent on the early whorls, base smooth.

Hedley, when he described his species, considered that it belonged to the subgenus *Heida* of Dall and Bartsch, but in their key *Heida* is placed with *Odostomia* having no transverse sculpture. Broadly it might be placed with *Elodiamea* De Folin, but the broad callus, the barrel-like form, and particularly the slight, narrow plication which forms the columella fold are good generic characters.

Rugadentia ignava Hedley.

(Figure 25.)

Hedley 1032.

This species is fairly well distributed along the coast from Trial Bay to Port Jackson. The specimen figured is from Pittwater, and is 5·2 mm. in length. Characters already mentioned in the generic description form ready recognition marks.

Rugadentia doliae, sp. nov.

(Figure 26.)

Shell of medium size, broad and solid, white, shining and sub-translucent. Protoconch small, heterotrophe and half submerged. Whorls five–six, early whorls increasing more rapidly than the later ones, giving the spire a curved contour, whorls slightly curved, suture impressed with a narrow but distinct shelf. The sculpture consists of rounded, transverse ribs, about twenty-four on the body whorl, well defined on the early whorls but becoming fainter and irregular on the body whorl, persisting below the periphery. Aperture ovate, extended anteriorly, outer margin simple, the whole of the inner margin strongly reflected and adhering to the body whorl as a band of callus. The columella fold is very slight but distinct and reduced to a small, narrow plication, nearly invisible from in front. Dimensions: The type (five whorls), 4·5 × 2·4 mm.; another specimen (six whorls), 5·5 × 2·8 mm.

Localities.—Dredged in 15 fathoms between the Heads, Port Jackson, on a sandy bottom (type); also in Pittwater.

Remarks.—This is closely allied to *R. ignava* Hedley, but can be readily separated by the much broader form, more distinct sculpture and the greater number of ribs, of which there are about twice as many to the whorl.

Genus **Elodiamea** De Folin, 1884.

Related to *Odostomia*, but with the shell inflated, summits of the whorls slightly shouldered. The sculpture consists of rounded, transverse ribs and there is no spiral sculpture. These characters, as outlined by Dall and Bartsch, fit several of the local species. To them might be added that the ribs may persist right to the base, or may stop at or below the periphery, leaving the base smooth. Laws accepts *Elodiamea* in the same sense as Dall and Bartsch.

Elodiamea caelatura, sp. nov.

(Figure 28.)

Shell small, conical, white, sub-translucent. Protoconch typically heterotrophe, half submerged. Mature whorls five, increasing regularly, body whorl about half total length, rounded, bent in sharply above to form a prominent shelf at the sutures. Sculpture consisting of broad, rounded, transverse ribs, slightly oblique, about eighteen on the body whorl, and persisting to the base. Aperture ovate, extended anteriorly, outer margin simple, rounded, inner margin slightly reflected, columella fold prominent. Operculum paucispiral, nucleus anterior and sub-marginal, a rounded indentation opposite the columella fold, covered with fine, sharply defined growth lines. Length, 2·8 mm.

Habitat.—Several specimens alive in mussel beds at low tide mark, North Harbour, Port Jackson (type); also in shell sand, Point Halliday; Angowrie; and 6–9 fathoms, Sow and Pigs Reef.

Elodiamea vincula, sp. nov.

(Figure 29.)

Shell conical, turreted, white and sub-translucent, small. Protoconch prominent, free from the summit, heterotrophe, recumbent, of two whorls, the nucleus comparatively large. Mature whorls five, increasing regularly, rounded, sharply infolded above into the sutures, giving the spire its turreted appearance. Sculpture consisting of regular, prominent, rounded, transverse ribs, slightly oblique, about twenty on the body whorl, base smooth. Aperture ovate, extended anteriorly, outer margin simple, rounded, inner margin slightly reflected. Columella fold obsolete. Operculum too far retracted for detailed observation, but it is apparently nearly smooth with the nucleus anterior. Length, 3·5 mm.

Habitat.—Alive on seaweed, North Harbour (type); also Angowrie, Woolgoolga, Port Stephens and Ocean Beach, Manly.

Remarks.—The absence of a columella fold suggests *Turbonilla*, but it seems so closely allied to the preceding species, that it is retained here. From *E. caelatura* it differs also in being much narrower. It illustrates the difficulty of separating species generically on one character alone, which otherwise would seem of full generic value.

Elodiamea opaca Hedley.

(Figure 30, after Hedley.)

Hedley 1036.

The type locality is Chinaman's Beach, Middle Harbour, but so far the collection of this species has eluded us. The length given is 2·95 mm., and it is buff-coloured with two coloured spiral bands. The very slight columella fold would seem to place it between *E. caelatura* and *E. vincula*.

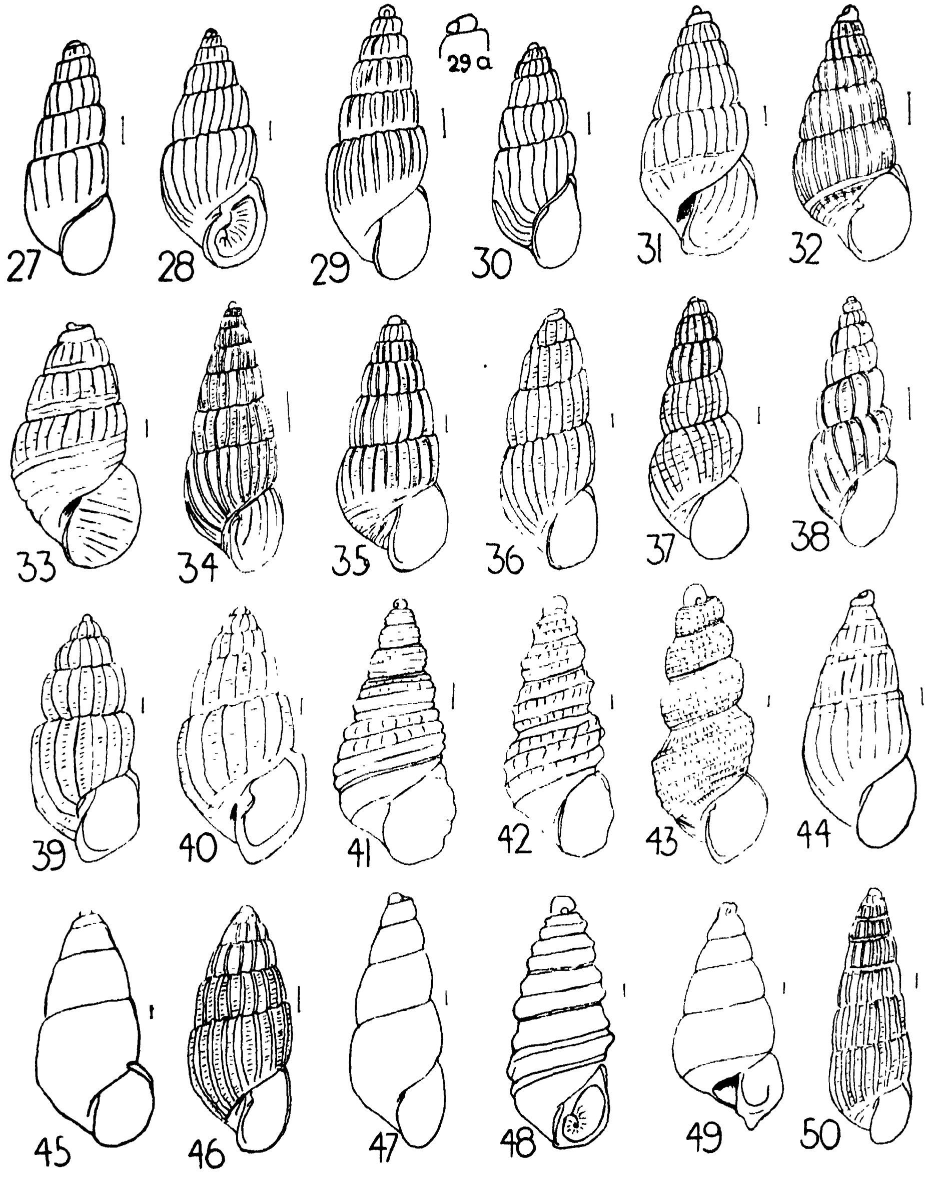
Elodiamea gunnamatta, sp. nov.

(Figure 44.)

Shell small, regularly conical, white, semi-translucent. Protoconch comparatively large, tilted, slightly larger than the apex of adult shell. Mature whorls four on type which may not be quite mature, increasing regularly, nearly flat, slightly constricted below the sutures which are moderately impressed. Sculpture irregular, consisting of low, rounded, transverse ribs, about eighteen to the whorl, persisting but becoming obscure on the base. Aperture sub-ovate, well extended anteriorly. Outer margin thin and rounded, inner margin thin and rounded, not reflected, columella fold almost obsolete, invisible from in front but just visible within the aperture. Length, 2·4 mm.

Locality.—Two specimens from shell sand, Gunnamatta Bay, Port Hacking.

Remarks.—It is doubtful if the type is quite mature, but even another whorl is not likely to affect the description given. The large protoconch, general form, and obscure ribbing distinguish it from the other species of the group.



Figures 27–50.

27, ***Pseudorissoina exserta*** Laseron. 28, ***Elodiamea caelatura*** Laseron. 29, ***E. vincula*** Laseron. 30, ***E. opaca*** Hedley (after Hedley). 31, ***Egila mayii*** Tate. 32, ***Paregila henni*** Brazier. 33, ***Linopyrga bisculpta*** Laseron. 34, ***L. pascoei*** Angas. 35, ***L. portseaensis*** Gatliff and Gabriel. 36, 37, ***L. brevis*** Pritchard and Gatliff. 38, ***L. ceria*** Laseron. 39, ***L. nugatoria*** Hedley (after Hedley). 40, ***L. pegma*** Laseron. 41, ***Miralda suprasculpta*** Ten.-Woods. 42, ***M. montuosa*** Laseron. 43, ***Pandorella declivita*** Laseron. 44, ***Elodiamea gunnamatta*** Laseron. 45, ***Odostomia tumera*** Laseron. 46, ***Linopyrga fornix*** Laseron. 47, ***Odostomia microlinea*** Laseron. 48, ***Oscilla tasmanica*** Ten.-Woods. 49, ***Myxa exesa*** Hedley (after Hedley). 50, ***Pyrgiscus gravicosta*** Laseron.

Genus **Egila** Dall and Bartsch, 1904.

Shells resembling *Elodiamea* in general characters, particularly the sculpture, which consists of transverse ribs alone without spiral striae. The main characteristic is, however, a double keel on the periphery with a shallow sulcus between.

Egila mayii Tate.

(Figure 31.)

May 963.

Several shells from the outer beaches are tentatively referred to *E. mayii*, which is either a new record for New South Wales, or they may ultimately prove to be new. The sulcus on the periphery, though narrow, is distinct, and brings them well within *Egila*. The shell is thin, transparent, the columella fold is very small, invisible from in front though distinct within the aperture. The figured specimen is from Port Stephens and is 3 mm. in length. We also have it from the Ocean Beach, Manly.

Genus **Paregila**, gen. nov.

Genotype, *Paregila henni* (Brazier).

Shell pyramidal, like *Egila* in general characters, with a double keel on the periphery and a sulcus between, but sculpture both transverse and spiral, the transverse consisting of strong ribs, weak on the base, the spiral of fine raised threads between the costae as in *Linopyrga*. Columella fold strong, protoconch large, tilted, heterotrophe.

Paregila henni Brazier.

(Figure 32.)

Hedley 1031.

Fairly common on the coast, it is easily recognized by two narrow keels on the periphery at which the prominent, transverse ribs abruptly terminate. The base is finely, spirally sculptured, and fine, spiral threads occur in the intercostal spaces higher on the whorl. The columella fold is very prominent. The specimen figured is from Shellharbour, and is 4 mm. long.

Genus **Linopyrga** Laws, 1941.

In seeking a name to include those New South Wales Odostomias with both spiral and transverse sculpture, it was at first intended to use *Pyrgulina* A. Adams in rather a wider sense than as used by Dall and Bartsch. In reviewing the Neozelandic species, Laws uses *Pyrgulina* in virtually a subfamily sense, his relevant paper (1941) being entitled "The Pyrgulinid Genera and the Genus Evalea." From *Pyrgulina* proper he separated certain species as a new genus *Linopyrga*, the main difference being that in *Pyrgulina* the intercostal spiral sculpture consists of fine incised lines, while in *Linopyrga* it consists of raised threads. Microscopic examination shows that all the New South Wales species are of the latter type, hence Laws' genus is used in preference to *Pyrgulina*. The common local species, *pascoei*, is very close to Laws' genotype, *rugata* Hutton, and these two at least are undoubtedly co-generic. For the remainder, the New South Wales species do not fit well with the Neozelandic types, and other new genera of Laws are not used, particularly as they are mainly for Cainozoic fossils. New South Wales species could easily be further subdivided by such characters as the persistence or non-persistence of the costæ below the periphery, by the shouldering of the whorls, and particularly by the strength or obsolescence of the columella fold. This would necessitate the introduction of still more generic names, a course not at present taken, as it is thought that the present needs of local systematists will best be served by the broader grouping.

Under *Linopyrga* will therefore be grouped those shells with medium to short spires, with predominant axial sculpture, consisting of transverse ribs which may or may not persist to the base. Spiral sculpture is always present, as numerous, sub-equal raised threads between the costæ. On those species in which the ribs do not reach the base the spiral sculpture is there continuous. The strength of the columella fold is variable, sometimes very strong, in other species nearly obsolescent.

Linopyrga pascoei Angas.

(Figure 34.)

Hedley 1037.

This is probably the commonest species of the whole family on the coast, and it is abundant, living under rocks in rock pools at low tide. The prominent transverse ribs, persistent right to the base, with the fine spiral ridges between, are good recognition marks. Young specimens of *L. pascoei* have rather a different facies and at first sight would often appear to be another species, but there is another, and closely related small species, which will be next described. The specimen here figured is from under rocks at low tide, Castle Rock, Middle Harbour, and is 6 mm. in length. Hedley (1916) figured the animal of the species.

Linopyrga fornix, sp. nov.

(Figure 46.)

Shell small, broadly conical, white, solid. Protoconch small, heterotrophe, half submerged. Mature whorls five, increasing regularly, stepped at the utures, the spire with a curved contour, the body whorl large, fully one-half of the total length. Sculpture consisting primarily of strong, rounded, broad, transverse ribs, in width equal to or wider than the spaces between, persisting to the base. The spiral sculpture consists of numerous fine threads, crossing the intercostal spaces but not the ribs. Aperture pyriform, produced anteriorly, outer margin curved, bent back posteriorly, inner margin curved, slightly reflected. Columella fold prominent, oblique. Length, 3·6 mm.

Locality.—6-8 fathoms, Pittwater.

Remarks.—This species is closely allied to *L. pascoei*. In any long series of *L. pascoei*, the young specimens can easily be misleading, and it was at first thought this was merely another of these. The well-formed aperture, however, shows a mature shell, and the curved contour of the spire, like a narrow gothic arch, is a ready recognition mark.

Linopyrga portsaeensis Gatliff & Gabriel.

(Figure 35.)

May 966.

A small species, from Ocean Beach, Manly, 2·5 mm. in length, has been tentatively identified as the Tasmanian species, but more material is needed before it can be fully confirmed. In the meantime it is here listed and figured for future reference. It is generally comparable with *L. pascoei*, but is smaller and the transverse ribs do not persist on the base. The columella fold is also very slight and is invisible from in front.

Linopyrga brevis Pritchard & Gatliff.

(Figures 36, 37.)

Hedley 1045 (*Turbonilla*).

This has been identified from specimens so labelled in the Australian Museum Figure 37 is from Bayview, Pittwater, and is 2·5 mm. in length. Figure 36 is a younger specimen from Eden Harbour with one less whorl and 2 mm. in length. The inflation of the body whorl gives the mature shell quite a different facies. *L. brevis* appears in both Hedley's and May's Check Lists as a *Turbonilla*, but it seems much closer to *Odostomia* and its relations than to *Turbonilla*. The columella fold, though practically obsolete in the mature shells, is present in the younger shells and is visible within the aperture even if invisible from in front. It is fairly common right along the coast.

Linopyrga ceria, sp. nov.

(Figure 38.)

Shell of medium size, elongate-conical, turreted, white. Protoconch probably heterotrophe, but nucleus infolded and hidden. Mature whorls six, increasing regularly, flattened at the periphery, angled below the sutures which are channelled. Sculpture primarily of well-defined, elevated, narrow ribs, about fourteen on the body whorl, persistent to the base. The inter-costal spaces are broad and flat, and covered with numerous fine, rounded, spiral ridges. Aperture ovate, well extended anteriorly, outer and inner margins simple. Columella fold invisible from in front but distinct within the aperture. Length, 4·5 mm.

Localities.—15 fathoms between Heads, Port Jackson (type); also from the reclamations, Tempe, Botany Bay.

Remarks.—This is a distinct and handsome species, easily recognized by its elongate shape and the narrow and distant ribs. It belongs to a group of species centring about *L. pascoei*, all of which have the initial whorls of the protoconch infolded, and small columella folds only visible within the aperture.

Linopyrga nugatoria Hedley.

(Figure 39, after Hedley.)

Hedley 1035.

A small species of distinctive shape, found only on the continental shelf. The type locality is 41-50 fathoms off Cape Three Points, and other specimens were collected by the "Thetis" Expedition from 63-75 fathoms off Port Kembla. The length given is 2·2 mm., the width 1 mm.

Linopyrga pegma, sp. nov.

(Figure 40.)

Shell small, pyramidal, white and solid. Protoconch typically heterotrophe, sinistral whorls two, the initial one minute, the second inflated. Mature whorls four, increasing regularly, slightly rounded, bent sharply above to form a broad shelf at the suture. Sculpture consisting of broad, rounded, transverse ribs, slightly oblique, tending to become obsolete on the body whorl and fading out on the base. These are crossed by very fine, continuous and even spiral ridges. Aperture ovate, bent in posteriorly, and extended anteriorly where it is acuminate. Outer margin rounded and evenly thickened, inner margin strongly reflected. Columella fold large and prominent, oblique. Length, 2 mm., width, approximately 1 mm.

Locality.—Bottle and Glass Rocks, Port Jackson (collected by Mrs. Rutland).

Remarks.—A distinctive species, nearer to *L. nugatoria* than to any other Australian species. It is readily distinguished by its broad, pyramidal shell, the acuminate aperture, and the prominent columella fold. It also resembles *L. crassicosta*, a Tasmanian deep-water species, but differs chiefly in the characters of the aperture and by its strong columella fold.

Linopyrga bisculpta, sp. nov.

(Figure 33.)

Shell small, broadly conical, white, translucent. The protoconch may be heterotrophe, but the nucleus is infolded in the first dextral whorl, which is slightly tilted. Mature whorls four, increasing regularly, slightly rounded, with a shelf above at the suture. The sculpture consists on the upper part of the whorl of regular, well-defined, broad rounded, slightly oblique, transverse ribs, about twenty-four on the body whorl, which extend to the periphery. The spiral sculpture on the upper part of the whorls is at first ill-defined, appearing as irregular threads in the intercostal spaces, but below the periphery and on the base it consists of numerous, well-defined, low and rounded keels. The uppermost two keels are visible above the suture in the earlier whorls. Aperture sub-circular large, extended anteriorly, outer margin simple and rounded, inner margin slightly reflected. Columella fold small, practically invisible from in front, but distinct within the aperture. Length, 2·3 mm.

Locality.—Port Stephens, a number of specimens from shell sand (type); Clontarf, Middle Harbour.

Remarks.—The broad form and distinctive sculpture are good features for recognition, and it cannot readily be confused with any other species. Generically, though placed in *Linopyrga*, it is merging on forms such as *Miralda* which have prominent spiral keels.

Genus **Miralda** A. Adams, 1864.

As defined by Dall and Bartsch, *Miralda* includes shells in which the "axial ribs are present but very feeble, usually indicated near the summit of the whorls. Spiral markings consist of several, strong, broad, tumid cords, one or more of the posterior cords crenulated." In a broad sense this can be applied to several Australian shells, the character to be emphasized being that the predominant sculpture is spiral, while the transverse sculpture, though present, is feeble.

Miralda suprasculpta Ten.-Woods.

(Figure 41.)

Hedley 1040.

This species may be recognized by the broad, rounded keels, the upper two of which are broken into rounded tubercles. The columella fold is nearly obsolete. The specimen figured is from shell sand, Port Stephens, and is 4 mm. in length.

Miralda montuosa, sp. nov.

(Figure 42.)

Shell small, conical, white, translucent. Protoconch typically heterotrophe, comparatively large. Mature whorls four, increasing regularly, sutures deeply impressed. The sculpture consists of three rounded sub-equal, spiral keels, a fourth appearing on the base of the body whorl. The centre keel is more elevated than the others. All are transversely indented, so that the summits are broken into regular, rounded tubercles. The base is smooth. Aperture ovate, slightly extended anteriorly, angled above, outer margin indented by the keels, inner margin slightly reflected. Columella fold nearly obsolete, invisible from in front but visible within the aperture. Length, 2 mm.

Locality. Gunnamatta Bay, Port Hacking, in shell sand.

Remarks.—This species is closely allied to *M. suprasculpta*, but is smaller, narrower, and has fewer keels, all of which have tubercles, and not only the upper two.

Genus **Latavia**, gen. nov.

Genotype, *Eulimella pulchra* Brazier.

Elongated shells, colourless and translucent, protoconch typically heterotrophe. Columella fold slight to practically obsolete. Sculpture predominantly spiral as in *Miralda*, but the spiral ribs are flat, and broadened until the spaces between are reduced to narrow channels. Transverse sculpture nearly obsolete, reduced to pittings in the channels and slightly more prominent on the upper part of the whorls.

Latavia pulchra Brazier.

(Figure 65.)

Hedley 1075.

It has been rather difficult to decide definitely what is Brazier's species. Unfortunately his original figure and description are quite different, and it is probable that the figure is that of an immature shell. However, our specimens agree with those labelled in the Australian Museum, some of which were collected by Brazier himself. The best recognition features are the broad, flat keels, separated by narrow channels, the channels divided by cross sculpture into minute, square pits. The species is common on the coast, the figured specimen, 5 mm. in length, being found alive under rocks at Long Reef.

Latavia tricarinata, sp. nov.

(Figure 64.)

Shell of medium size, elongated conical, white and translucent. Protoconch small, typically heterotrophe. Mature whorls seven, increasing regularly, sutures deeply channelled. Sculptures consisting of spiral keels, three on the earlier whorls, five on the body whorl, two of which are on the base. The keels are flattened and separated by deep but narrow channels. The transverse sculpture is more noticeable on the two upper keels, which tend to be broken into tubercles, but it persists as microscopic oblique lines right on to the base. Aperture sub-quadrate, extended anteriorly, the outer margin thin and indented by the keels, the inner margin not reflected. Columella fold invisible from in front but prominent within the aperture. The operculum was too far retracted to observe. Length, 5 mm.

Habitat.—Alive under stones in rock pools, Long Reef.

Remarks.—This species was found in living association with *L. pulchra*, which it generally resembles, but from which it can be readily separated. It is relatively broader, it has a distinct columella fold within the aperture, and it differs in the details of its sculpture.

Genus **Pandorella**, gen. nov.

Genotype, *Pandorella declivita* Laseron.

Shell minute, conical, white and translucent. Protoconch heterotrophe. Sculpture predominantly spiral, whorls sharply angulated, sutures greatly restricted. The spiral sculpture consists of numerous sub-equal, rounded keels, persistent to the base, and crossed by fine threads producing a microscopic cancellation. Columella fold present but slight.

Pandorella declivita, sp. nov.

(Figure 13.)

Shell minute, conical, white and translucent. Protoconch heterotrophe, relatively small, but prominent, laterally placed and about half the diameter of the summit. Mature whorls four, angled at the periphery, constricted below, and sloping above to the sutures which are greatly constricted. The sculpture consists of about seven sharp, narrow, keels, spaced evenly from the periphery to the base. These are crossed by numerous, very fine, transverse lines, producing a microscopic cancellation. Aperture ovate, well extended anteriorly where it is sub-acuminate, outer margin thin, bent back posteriorly, inner margin reflected. Columella fold slight but distinct. Length, 1·4 mm.

Locality.—From shell sand, Gunnamatta Bay, Port Hacking.

Remarks.—This beautiful little species is one of a number which occur on the Australian coast which do not fit into any known genus, and each of which must be considered by itself. Its characters are so distinctive that it cannot readily be confused with any other species.

Genus **Cinctiuga**, gen. nov.

Genotype, *Cingulina diaphana* Verco.

Shell small, thin, translucent. Whorls very sharply angled at the periphery, greatly restricted at the sutures. The sculpture is entirely spiral, consisting of numerous rounded keels. Operculum with large nucleus, anterior but sub-centrally situated.

This needs generic separation from *Cingulina*, which includes solid shells, with no angulation at the periphery. It has an entirely different facies.

Cinctiuga diaphana Verco.

(Figure 77.)

This is another of the odd Australian shells which needs a genus to itself. It is not uncommon on beaches right along the coast and we have found it alive on seaweed in rock pools at North Harbour, the figured specimen 2·5 mm. in length. It can be readily recognized by its acutely angled whorls, greatly restricted sutures, and peculiar sculpture. The operculum is paucispiral, the nucleus large and sub-central.

Genus **Oscilla** Adams.

Shell small, tumid, solid, sculpture entirely spiral, with few, broad, rounded keels, columella fold obsolete, operculum paucispiral, with anterior but sub-circular nucleus.

Oscilla tasmanica Ten.-Woods.

(Figure 48.)

Hedley 1027.

This beautiful little species is quite common on the coast, living on seaweed in many localities. The specimen figured is from seaweed from North Harbour, and is 2 mm. in length. The colour is pink, and the peculiar form and sculpture make it readily distinguishable from any other species.

Genus **Myxa** Hedley.

Related to *Odostomia*, small, white and pyramidal, protoconch heterotrophe, no columella fold, and umbilicate.

Myxa exesa Hedley.

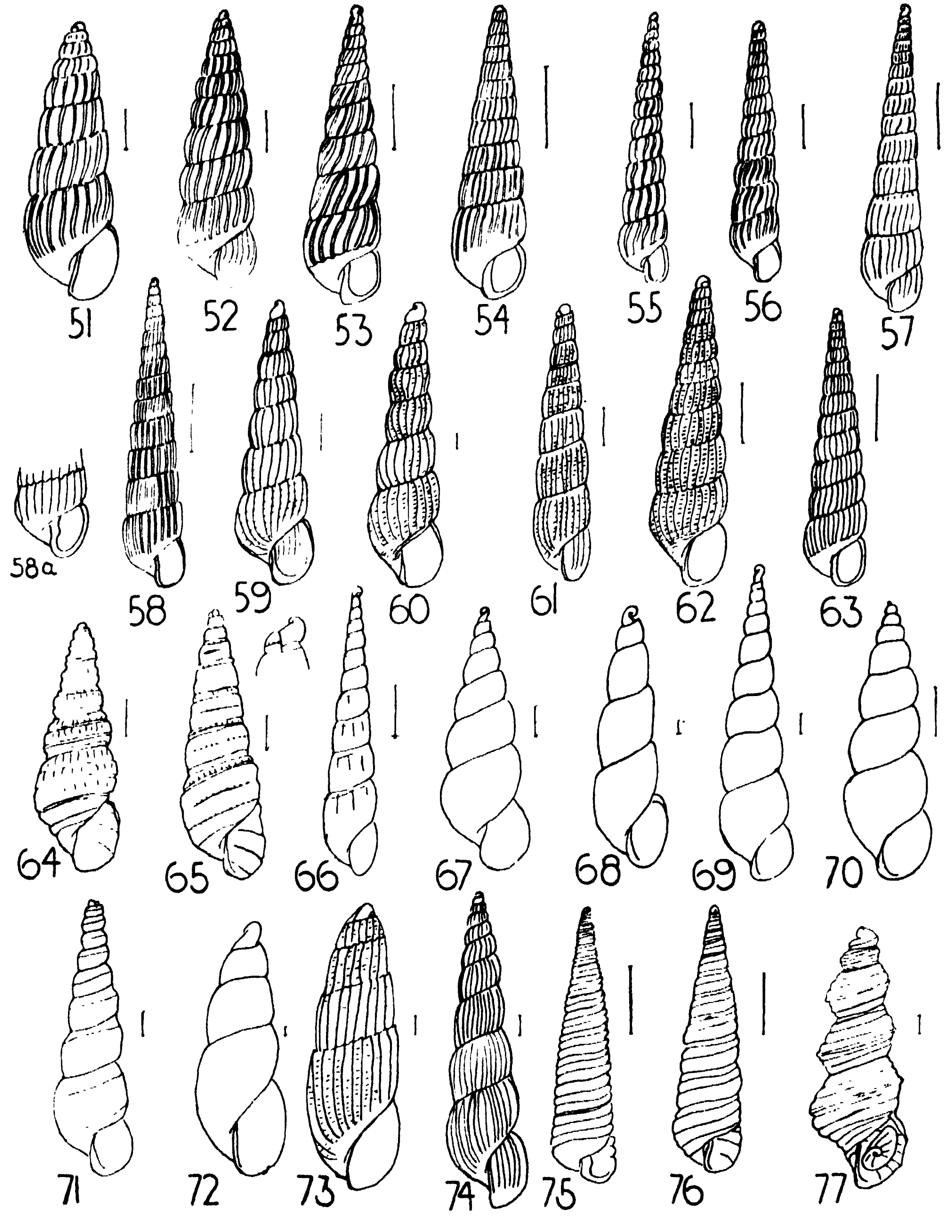
(Figure 49, after Hedley.)

Hedley 1028.

The type locality is from 41–50 fathoms off Cape Three Points, the specimen figured 1·6 mm. × 0·8 mm. An inhabitant of the continental shelf, I have not yet seen this species, but the broad, pyramidal shell, with the umbilicate base, should make it easy of recognition.

Genus **Turbonilla** Risso, 1826.

If certain discordant elements such as *Cingulina* be removed from *Turbonilla* as defined by Dall and Bartsch, it forms a large natural genus or group of genera with a similar facies throughout the world. Dall and Bartsch, as stated in the introduction, divided *Turbonilla* into many sections and subgenera, which was not altogether in accordance with Linnean nomenclature. Laws (1939), in his work on Neozelandic fossil and recent species, realized this and adopted a much more satisfactory classification, providing a key which is readily followed. Opinions may differ as to the characters sufficient for generic separation, and some of the genera proposed might seem to be based on rather slight differences, but on the whole his key is a natural one, and most of the New South Wales species fit in well with it.



Figures 51-77.

51, *Turbonilla beddomei* Petterd. 52, *Chemnitzia hofmani* Angas. 53, *C. mariae* Ten.-Woods. 54, *C. gravis* Laseron. 55, *C. acicularis* Adams. 56, *C. acicularis*, var. *similis* Laseron. 57, *C. vana* Laseron. 58, 58a. *Turbonilla scalpidens* Watson. 59, *Pyrgiscus fusca* Adams. 60, *P. infans* Laseron. 61, *P. hedleyi* Laseron. 62, *P. varicifera* Tate. 63, *Chemnitzia propinqua* Laseron. 64, *Latavia tricarinata* Laseron. 65, *L. pulchra* Brazier. 66, *Eulimella hasta* Laseron. 67, *E. moniliformis* Hedley and Musson. 68, *E. turrita* Petterd. 69, *E. coacta* Watson. 70, *E. tomacula* Laseron. 71, *E. anabathron* Hedley. 72, *E. minutissima* Laseron. 73, *Pyrgiscus pinguis* Laseron. 74, *Turbonilla thornleyana* Laseron. 75, *Cingulina spina* Crosse and Fischer. 76, *C. circinata* Adams. 77, *Cinctiuga diaphana* Verco.

Some Neozelandic genera, particularly among the fossils, are absent from New South Wales, and the local genera, though capable of further subdivision, may be reduced to four, with a ready key for their separation. Two local species, those here called *Turbonilla thornleyana* and *Chemnitzia ambulata*, have such distinctive characters as to warrant probable generic rank, but as they otherwise fit into the key adopted, this course has not been taken.

What might be termed the Turbonilla genera have these characters in common: they include elongate, often acicular shells, many-whorled, the columella fold obsolete or entirely absent, the protoconch heterotrophe, well exserted, often recumbent on the apex of the mature shell, the sculpture predominantly strong, transverse, rounded ribs or costae, often slanting. Spiral sculpture may be absent or present, but is restricted to fine lines between the costae.

The absence or presence of spiral sculpture at once divides the group into two sections, the former generally white, the latter frequently coloured and with brown spiral bands. For the further division of these, Laws uses the intercostal grooves which may terminate abruptly at the periphery, their excavation being below the general surface of the shell, or they may fade out on the base. Using these characters as a basis, we get the following key for the four New South Wales genera, a key which will also be found applicable to species from Queensland, Tasmania and southern Australia.

Key to the Turbonilla Genera

1 Without spiral sculpture.	
A. Intercostal grooves fading on the base	*Turbonilla* Risso
B. Intercostal grooves terminating at the periphery	*Chemnitzia* D'Orbigny
2 With spiral sculpture.	
A. Intercostal grooves fading on the base	*Pyrgiscus*
B. Intercostal grooves terminating at the periphery	*Pyrgiscilla* Laws

Turbonilla beddomei Petterd.

(Figure 51.)

Hedley 1044.

The specimen figured comes from Huskisson, Jervis Bay, and is 5 mm. in length. It agrees very well with specimens in the Australian Museum, labelled from Sydney and marked "compared with type". Similar specimens from Middle Harbour are the type of Brazier's *T. scalarina*, which Hedley synonymized under *T. beddomei*. In May's Tasmanian list, *beddomei* is shown as a shell with the transverse ribs practically obsolete, and it is possible that this is another species altogether. *T. beddomei* may be recognized, as it is the broadest of all the local species.

Turbonilla scalpidens Watson.

(Figures 58, 58a.)

Hedley 1052.

This species is confined to the continental shelf, mainly in depths of about 60 fathoms. The specimen figured is from 30–35 fathoms, off Crookhaven, and is 9 mm. in length. It is not quite typical, being slightly slenderer than the figured type. Figure 58a shows the aperture of a more typical specimen, 7·5 mm. long, in the Australian Museum. The columella here shows a very slight plication in the columella, a character previously figured by Hedley (1903). Characteristic of this species are the strong, straight ribs, in the earlier whorls standing above the suture, and producing a turreted appearance similar to that of *Chemnitzia vana*.

Turbonilla thornleyana, sp. nov.

(Figure 74.)

Shell small, acicular, colourless, thin and transparent. Protoconch small, heterotrophe. Mature whorls nine, increasing regularly, rounded and inflated, constricted at the sutures. Sculpture consisting of numerous fine, low, rounded, transverse ribs, about thirty on the body whorl. Aperture greatly extended anteriorly, outer margin thin and rounded, inner margin straight and slightly reflected. Length, 2·5 mm.

Locality.—Shell sand, Patonga, collected by Miss G. Thornley, of the Marine Section, Royal Zoological Society, after whom the species is named.

Remarks.—This beautiful and delicate little species is quite unlike any other Australian *Turbonilla*, and it is rather doubtfully referred to that genus. It might be likened to the Eulimellas in general form, but differs of course in the typical Turbonilla sculpture. The delicate, transparent shell, the rounded whorls and constricted sutures are good recognition points.

Chemnitzia hofmani Angas.

(Figure 52.)

Hedley 1050.

This is the commonest of the New South Wales species, and it occurs in many locations right along the coast. Its general habitat is on seaweed, occasionally so abundantly as to be considered gregarious. The specimen figured, 5 mm. in length, is from kelp, Snails Bay, Port Jackson, and we have also found it in mussel beds in North Harbour, under rocks in the same locality, and on weed from 4 fathoms, Woollahra Point, and from 2 fathoms, Port Hacking. It is much narrower than *T. beddomei*, yet broader than most of the other local species.

Chemnitzia mariae Ten.-Woods.

(Figures 53, 98.)

Hedley 1051.

The specimen figured comes from the beach at Huskisson, Jervis Bay, and is 8·5 mm. in length. It generally resembles *T. hofmani*, but is larger, slenderer, more solid and with fewer ribs.

Chemnitzia gravis, sp. nov.

(Figure 54.)

Shell large, elongate, massive, white. Protoconch unknown, apparently deeply infolded in apex. Mature whorls eleven, increasing regularly, slightly rounded, body whorl short, sutures moderately impressed. Sculpture consisting of numerous broad, rounded, transverse ribs, much wider than the channels between, about twenty-two on the body whorl, and fading on the base. Aperture sub-quadrate, produced anteriorly, thickened, inner margin widely reflected. Length, 11 mm. (type), other specimens more than 12 mm.

Localities.—Patonga Beach (collected by Miss G. Thornley, type); Crookhaven Heads; 6–9 fathoms, Sow and Pigs Reef.

Remarks.—Generally resembles *C. mariae*, but is much larger and more massive and with more numerous and broader ribs. The narrow intercostal spaces are a useful recognition mark. Fragments of a similar but even larger form come from 14 fathoms off Long Reef, the length of one imperfect specimen being estimated at more than 16 mm. This may ultimately prove to be an undescribed species; in the meantime *C. gravis* may be considered the largest of the New South Wales species.

Chemnitzia acicularis Adams.

(Figure 55.)

May 970.

This was identified from Tasmanian specimens in the Australian Museum. It is thus a new record for the State. It is not uncommon from North Harbour, the specimen figured being 5·5 mm. in length. It may be distinguished by the extremely attenuate form, and the few large, prominent, oblique ribs, about eleven–twelve on the body whorl.

Chemnitzia acicularis Adams, var. **similis**, var. nov.

(Figure 56.)

While studying a series of *C. acicularis* from North Harbour, a number of specimens were sorted out which at first sight appeared a distinct series, chiefly on account of the slightly broader form, and the greater number of ribs, about fifteen on the body whorl. Examination of other series from Port Stephens and Huskisson, however, disclosed intermediate specimens, and it was concluded that *C. acicularis* is a variable species within these limits. For purposes of record, the variety is given a name, the specimen figured from North Harbour being 6 mm. in length.

Chemnitzia vana, sp. nov.

(Figure 57.)

Shell comparatively large, acicular, white, translucent. Protoconch typically heterotrophe, comparatively large, the initial whorl minute, the second greatly inflated. Mature whorls thirteen, rather flattened, contracted above to the suture. Sculpture consisting of regular, rounded, transverse ribs, about twenty–twenty-two on the body whorl, in width about equal to the spaces between, and slightly contracted just below the suture. Owing to the translucent shell the overlap of preceding whorls is visible and from some angles produces the illusion that the ribs are interrupted and fail to reach the suture above. The ribs end on the periphery of the body whorl, and the base is smooth. Aperture small, ovate, produced anteriorly, outer margin thin, inner margin curved, very slightly reflected. Length, 8·2 mm.; width, 1·5 mm.

Locality.—6–9 fathoms, Sow and Pigs Reef, Port Jackson, several specimens (type); 4–6 fathoms, off Kurnell, Botany Bay; Cronulla.

Remarks.—This species resembles *acicularis*, but it is larger, the aperture is of different shape, the inner margin is less reflected, and the ribs are more numerous and less oblique. It differs from *T. scalpidens* by being narrower, and by the details of its sculpture.

Chemnitzia propingua, sp. nov.

(Figure 63.)

Shell comparatively large, attenuate, white, solid. Protoconch typically heterotrophe. Mature whorls thirteen, increasing regularly, early whorls flattened, becoming later slightly rounded, sutures impressed, the early whorls turreted. Sculpture prominent, consisting of very numerous, well-defined, rounded, transverse ribs, about thirty on the body whorl, the width of the ribs about equal to the spaces between. The ribs reach the suture and even stand above it, particularly in the early whorls, giving them their turreted appearance. On the body whorl the ribs terminate abruptly at the periphery and the base is smooth. Aperture sub-quadrate, small, produced anteriorly, outer and anterior margins rounded, inner margin nearly straight, reflected. Length, 9 mm.

Locality.—Port Stephens, several specimens.

Remarks.—Of the larger species of *Chemnitzia* this has the finest sculpture. The early turreted whorls resemble those of *C. scalpidens*, but here again the finer sculpture distinguishes it.

Chemnitzia ambulatia, sp. nov.

(Figure 93.)

Shell turreted, elongate, colourless, glassy and transparent. Protoconch typically heterotrophe. Mature whorls eight, short, increasing regularly, flattened, broadest at the top where they form a broad shelf, and tapering to the suture below. Sculpture consisting of prominent, broad, rounded, transverse ribs, slightly curved and oblique, about fifteen on the body whorl, equal in width to the intercostal spaces, bent in sharply above to form the shelf at the suture, ending abruptly on the periphery. The intercostal spaces smooth and excavate, also ending on the periphery where, with the ends of the costae, they form a sharply defined line. The base smooth and slightly excavate. Aperture rhomboidal, produced anteriorly, outer margin thin, sharply angled posteriorly, inner margin straight, slightly reflected anteriorly. The transparent shell shows the external sculpture clearly visible within the aperture. Length, 4 mm.

Locality.—Long Reef, in shell sand.

Remarks.—This novelty, which came to hand after the main part of this paper had been completed, is so unlike any other *Chemnitzia* which has so far been described from the Australian coast, that I have no hesitation in giving it specific rank. In its proportions it generally resembles *C. hofmani*, but can be distinguished at once by the narrow whorls, the broad shelf just below the suture, the whorls tapering below, and the rhomboidal aperture.

Pyrgiscus fusca Adams.

(Figure 59.)

Hedley 1049.

This is the first of several species which have spiral sculpture as well as transverse ribs. It is quite common on the beaches right along the coast, and in Tasmania. It may be readily recognized by the delicate, translucent shell, rounded whorls, pale yellowish colour with two well-defined, narrow, brown-yellow bands. The specimen figured is from North Harbour, Port Jackson, and is 5 mm. in length.

Pyrgiscus infans, sp. nov.

(Figure 60.)

Shell minute, acicular, white (probably bleached), translucent. Protoconch comparatively large, typically heterotrophe. Mature whorls six, increasing regularly, rounded, constricted at the sutures. Sculpture consisting of narrow, well-defined, transverse ribs, about eighteen on the body whorl, persisting to the base, slightly oblique, in width about one-half of the spaces between. The spiral sculpture consists of numerous fine, well-defined lines, which cross the intercostal spaces but not the main ribs. Aperture rounded on both the outer and anterior margins, well-produced anteriorly, slightly reflected on the inner margin. Length, 2 mm.

Localities.—Gunnamatta Bay, Port Hacking (type); Port Stephens from shell sand.

Remarks.—This greatly resembles *P. fusca*, of which it was at first thought to be an immature specimen but, even allowing for a whorl less, it is less than half the size. In *P. fusca* also, the transverse ribs in width are about equal to the intercostal spaces; in *P. infans* they are only about one-half.

Pyrgiscus hedleyi, sp. nov.

(Figure 61.)

Shell of medium size, elongate, fairly solid, sub-translucent, pale golden-brown with a deeper band on the periphery. Protoconch comparatively large, typically heterotrophe, initial whorl small, second whorl inflated. Mature whorls eight, increasing regularly, nearly flat, very slightly constricted at the sutures to form a narrow shelf. Sculpture consisting of numerous straight, regular, rounded, transverse ribs, about twenty-five on the body whorl, in width about equal to the spaces between, and stopping abruptly just below the sutures, leaving a smooth, hollow space, which macroscopically appears as a band. The spiral sculpture consists of numerous fine lines, which cross the ribs. Aperture well extended anteriorly, outer margin nearly flat, anterior and inner margins rounded, the latter slightly reflected. Length, 5 mm.

Localities.—Crookhaven Heads (type); Pittwater; also numerous specimens in stralian Museum collected by J. Brazier from the Bottle and Glass Rocks, Port Jackson.

Remarks.—This beautiful species has long needed a name. The Australian Museum specimens are labelled *Turbonilla* sp., and it is evident that the late Charles Hedley recognized it as undescribed. It is now named after him. Though belonging to the *fusca* group, it cannot be readily confused with that or any other Australian species. The nearly flat whorls and the abrupt termination of the transverse ribs below the suture are good recognition points.

Pyrgiscus pinguis, sp. nov.

(Figure 73.)

Shell small, conical, white. Protoconch comparatively large, heterotrophe, initial whorl minute, second whorl inflated, flattened, and tilted. Mature whorls four, body whorl elongated, about half the total length, flattened. The sculpture consists of numerous straight, well-defined, transverse ribs, about half the width of the intercostal spaces, about eighteen on the body whorl, less defined on the base, but standing above the sutures, and slightly indented below. The spiral sculpture consists of well-defined narrow ridges, which do not cross the ribs, but divide the intercostal spaces into regular square cells. Aperture ovate, produced anteriorly, very slightly reflected on the inner margin. Length, 2·3 mm.

Locality.—Reclamations, Carss Park, Botany Bay.

Remarks.—In spite of the few whorls, I think the type is mature, but even if not quite so, it is quite distinctive from young specimens of such species as *P. fusca* and *P. hedleyi*. The peculiar contour, the elongated body whorl and details of sculpture are good recognition points.

Pyrgiscus flexicosta, sp. nov.

(Figure 92.)

Shell small, conical, white, translucent. Protoconch typically heterotrophe. Mature whorls six, later whorls increasing more rapidly, making the spire slightly convex in contour, slightly rounded, sutures indented. Sculpture both transverse and spiral, the transverse ribs strong and rounded, slightly indented below the suture, in width about equal to the intercostal spaces, about eighteen on the body whorl, persisting but becoming less prominent on the base. Spiral sculpture not prominent, consisting of numerous fine lines crossing the intercostal spaces but not the ribs. Aperture pyriform, extended anteriorly, outer and anterior margins rounded, inner margin slightly reflected. Length, 3·5 mm.

Localities.—Dredged 6–9 fathoms, Pittwater (type): reclamations, Carss Park, Botany Bay.

Remarks.—In appearance this is near *P. gravicosta*, but is larger, rather broader, the aperture is slightly different in shape, the ribs are not so prominent, stopping at the suture and indented just below it, making a slight but noticeable depressed band.

Pyrgiscus varicifera Tate.

(Figure 62.)

Hedley 1053.

Though first recorded from New South Wales from deep water in 111 fathoms off Cape Byron, a fairly common beach shell is more clearly referable to Tate's species.

It is commonest on the south coast, and the specimen figured is from Huskisson, Jervis Bay, and is 8 mm. long. It is the largest and stoutest of the local species with cross sculpture, and may also be recognized by two brown bands, though these are sometimes faded on beach specimens. It is also slightly variable in width. In some specimens the costae appear to stop at the periphery, which would bring it within *Pyrgiscilla,* but more critical examination shows that they persist and fade out on the base.

Pyrgiscus gravicosta, sp. nov.

(Figure 50.)

Shell small, elongately conical, white and solid. Protoconch heterotrophe, laterally placed on the summit. Mature whorls seven, nearly flat, increasing more rapidly at first, making the spire slightly convex. Sculpture consisting of stout, rounded, straight transverse ribs, in width about equal to the intercostal spaces, but thickening at their summits and connected by a spiral ridge just below the suture. The costae are prominent to just below the periphery but fade out on the base. The spiral sculpture consists of numerous narrow ridges crossing the intercostal spaces, but not the ribs, and continuous on the base. Aperture ovate, extended anteriorly, inner margin not reflected. Length, 2·6 mm.

Localities.—6–8 fathoms, Pittwater, Broken Bay (type); Middle Harbour; also abundant in dredgings from 6–8 fathoms, Doll's Point, George's River.

Remarks.—This species is remarkably constant from the various localities. The minute size, solid little shell, and convex spire are good recognition points.

Pyrgiscilla kitcheni, sp. nov.

(Figure 94.)

Shell long and slender, white, trace of orange bands. Protoconch typically heterotrophe. Mature whorls eleven, increasing regularly, slightly rounded, sutures indented. Sculpture strong, consisting primarily of prominent, rounded, transverse ribs, about thirteen to the whorl, reaching right to the sutures and ceasing abruptly on the periphery. The ribs are generally slightly narrower than the intercostal spaces, but are on occasion much broadened and may even merge together. This happens most frequently about the fifth or sixth whorl, and suggests a former thickening of the aperture with subsequent renewed growth. Radial sculpture prominent, consisting of numerous fine, parallel grooves, not ridges, in the intercostal spaces. The groove on the periphery is generally more deeply excavated level with the terminations of the costae, producing a distinct line. The radial grooves persist on the base. Aperture ovate, greatly extended anteriorly, outer margin rounded, inner margin straight and strongly reflected. Length, 7 mm.

Locality.—Dredged in 6 fathoms, Quarantine Bay, Port Jackson.

Remarks.—This is the only New South Wales species which can fairly be referred to Laws' *Pyrgiscilla.* Its slender form and strong cross sculpture are good recognition points. Several specimens sorted out from the same dredging have rather finer sculpture but are otherwise similar. It is possible that still another species is indicated, but more material is needed to settle this point. It is named after Mr. Geoffrey Kitchen, an enthusiastic collector who participated in the dredging and sorted it from the material obtained.

Genus **Eulimella** Forbes.

Eulimella as it stands is not a very satisfactory genus. It is included by Dall and Bartsch as a subgenus under *Pyramidella,* in that section with two columella plaits. It is hard to see any justification for this, as the genotype, as well as all other species referred to *Eulimella,* has no columella fold, and is otherwise nearer to the Turbonillas than to the Pyramidella group of genera. The group is a complex one, and there is little information on which to base a genetic study. The interpretation of the genus by Australian conchologists has been to include elongated, often acicular shells, without sculpture, thin, white and transparent, with simple apertures and no columella fold, and with heterotrophe protoconchs often eccentric, prolonged and set at an angle. One local species at least is estuarine, and when more is known of the habitat and of the living animal, it is quite possible that some of the species will be found to be in no sense related.

Laws (1938) divides the New Zealand Eulimellas into two genera based on the protoconch. He restricts *Eulimella* to shells on which the " protoconch [is] not strongly exsert, of several turns, low helicoid, lateral nucleus small and central." He proposes the new genus *Terelinella* for shells " with protoconch very exsert, of one turn, lateral nucleus large and eccentric." Both types with further variations occur amongst the New South Wales species, but the division does not fit in with other shell characters. As the number of local species is small, and the material, with the exception of *E. moniliformis*, is rather sparse, the name *Eulimella* is retained for all, though some future revision in classification is certainly indicated

Eulimella moniliformis Hedley & Musson.

(Figure 67.)

Hedley 1074.

Discovered in 1891 in brackish water in the lagoon at Manly, this species eluded rediscovery for many years. We subsequently found it abundantly in the lagoon at Dee Why, living in the sand at the roots of reeds and grass at the edge of the water. It is probably not uncommon in similar locations elsewhere but is not easy to find. The specimen figured is larger than the type and is 4 mm. in length. The shell is of very simple character, thin and translucent, with rounded whorls, and greatly constricted sutures.

Eulimella hasta, sp. nov.

(Figures 66, 96.)

Shell comparatively large, acicular, white and translucent. Protoconch comparatively large and prominent, larger than the summit of the shell. Mature whorls ten, elongated, increasing regularly, flattened, bending in slightly above to meet the suture, below which is a nearly opaque narrow band. Under an ordinary magnifying glass the surface is smooth, but the microscope reveals irregular growth lines which occasionally thicken irregularly to an obscure varix. Aperture elongated oval, well extended anteriorly, simple and not reflected. Length, 7 mm.. width, 1·2 mm.

Localities.—Sydney Harbour (type), in Australian Museum, C31817, presented by C. Hedley: also 5 fathoms Jervis Bay; and an immature specimen, 14 fathoms off Long Reef.

Remarks.—The specimen in the Australian Museum is labelled *Turbonilla*, sp. nov., probably on account of the obscure transverse sculpture, but it seems much nearer to the local interpretation of *Eulimella* than to *Turbonilla*. It can be readily recognized by its acutely acicular form.

Eulimella turrita Petterd.

(Figures 68, 97.)

Hedley 1076.

This species was recorded from New South Wales from 111 fathoms off Cape Byron, but the only specimen in the Australian Museum labelled *E. turrita* is from 100 fathoms off Wollongong, and is quite another species altogether. It is dealt with elsewhere in this paper. However, two specimens from Balmoral in our collection match both the original figure and description very well and are taken as that species. The specimen figured is 1·6 mm. in length.

Eulimella coacta Watson.

(Figure 69.)

May 1003.

This agrees very well with Tasmanian specimens from deep water, 40-60 fathoms, which May describes as not quite typical of Watson's species. The specimen illustrated is from shell sand, Port Stephens, and is 3 mm. in length. If identified correctly it is a new record for the State, but it is possible that more material may show that it is either undescribed or that more than one species is indicated. It is not unlike *E. moniliformis*, but is smaller and slenderer and has more whorls.

Eulimella tomacula, sp. nov.

(Figure 70.)

Shell comparatively large, elongated, white, shining and translucent. Protoconch minute, barely visible, infolded in the apex. Mature whorls seven, rather irregular in growth, the penultimate whorl in the type nearly as large as the body whorl, rounded, constricted at the sutures. The surface is smooth and polished and there is no sculpture. Aperture ovate, produced anteriorly, outer margin thin and rounded, inner margin rounded and reflected. Length, 6·5 mm.

Localities.—Manly (type), specimen in Australian Museum, C36516, collected by Miss L. Parkes; also from Shoal Bay, Port Stephens.

Remarks.—In general form resembles *E. moniliformis*, but is larger, the aperture has a different shape and the inner margin is reflected: the protoconch is also very different.

Eulimella anabathron Hedley.

(Figure 71.)

Hedley 1073.

This has been rather doubtfully identified, as the type in the Australian Museum has become corroded, and our specimens do not quite match Hedley's figure. The type locality is Balmoral Beach, the specimen figured is from Manly Beach and is 3 mm. in length. The slight angularity mentioned by Hedley is rather more marked in this specimen, amounting to a distinct keel below the suture. If not *E. anabathron* it is an undescribed species.

Eulimella minutissima, sp. nov.

(Figure 72.)

Shell minute, conical, white and shining. Protoconch comparatively large and prominent, heterotrophe, elongated and tilted. Mature whorls three, increasing regularly, rounded and constricted at the sutures. There is no sculpture and the surface is smooth and shining. Aperture ovate, extended anteriorly, outer margin thin and rounded, inner margin rounded, not reflected. Length, 1 mm.

Localities.—6–9 fathoms, Sow and Pigs Reef, Port Jackson (type); also on seaweed, 4 fathoms, Woollahra Point.

Remarks.—This is the smallest of the local species. It was at first thought to be the young of one of the other species such as *E. moniliformis, coacta* or *tomacula*, but careful comparison shows it to be quite different and apparently mature. Its minute size is its best recognition point.

Eulimella, sp.

(Figure 87.)

This is an undescribed species, but unfortunately the only specimen available for a type is in the Australian Museum and is partially corroded and liable to quick disintegration. This is labelled C18256 from 100 fathoms off Wollongong, with Hedley's pencil notation *E. turrita* Petterd. It is, however, nothing like that species. I have refrained from naming it until more permanent material is found, but in the meantime it may be recorded, and the following characters noted. Length of shell, 3·8 mm., smooth, white and shining, with a translucent band below the sutures, protoconch heterotrophe, mature whorls eight, flattened, aperture subquadrate, inner margin reflected.

Genus **Cingulina** Adams.

Cingulina was placed by Hedley in the Acteonidae, but Dall and Bartsch included it in the Pyramidellidae as a subgenus of *Turbonilla*. With *Turbonilla* it has little in common, and from the Australian species would appear to be a natural genus, consisting of elongate shells with the typical protoconchs of the Pyramidellidae, no columella folds, and spiral sculpture consisting of a few, prominent, sub-equal keels. From the evenness of the keels it is often difficult to determine just where the sutures lie.

Cingulina spina Crosse & Fischer.

(Figure 75.)

Hedley 1018.

This is a common species on the beaches right along the coast, but so far has not been found alive. The specimen figured came from the mud flats at North Harbour, and is 9 mm. in length. The long, tapering shell, flat whorls, and prominent spiral sculpture make it easy of recognition.

Cingulina circinata Adams.

(Figure 76.)

Hedley 1017.

This is also fairly common on the beaches along the coast, and has not been found alive. The specimen figured comes from Shelly Beach, Manly, and is 8 mm. in length. It is generally like *C. spina*, but is somewhat broader and differs in details of the sculpture and in the shape of the aperture.

Genus **Pseudorissoina** Tate & May.

Dall and Bartsch included *Pseudorissoina* as a subgenus of *Odostomia*, to which it is allied, but with a complete peristome, and columella fold obsolete. The genotype is a South Australian species, and Hedley placed under it two small New South Wales species from the continental shelf. Neither, however, conforms to the generic description, nor do they seem to be cogeneric with each other. A great many of the species from deepwater on the eastern Australian coast seem isolated in relationship, and are difficult to fit into any accepted scheme of classification. It is probable that their affinities are rather in the past than with living molluscan faunas elsewhere. Unfortunately here there is insufficient material for immediate study, and the two species listed by Hedley are for the time being kept under *Pseudorissoina*, though ultimately their systematic position will need revision.

Pseudorissoina exigua Hedley.

(Figure 88.)

Hedley 1068.

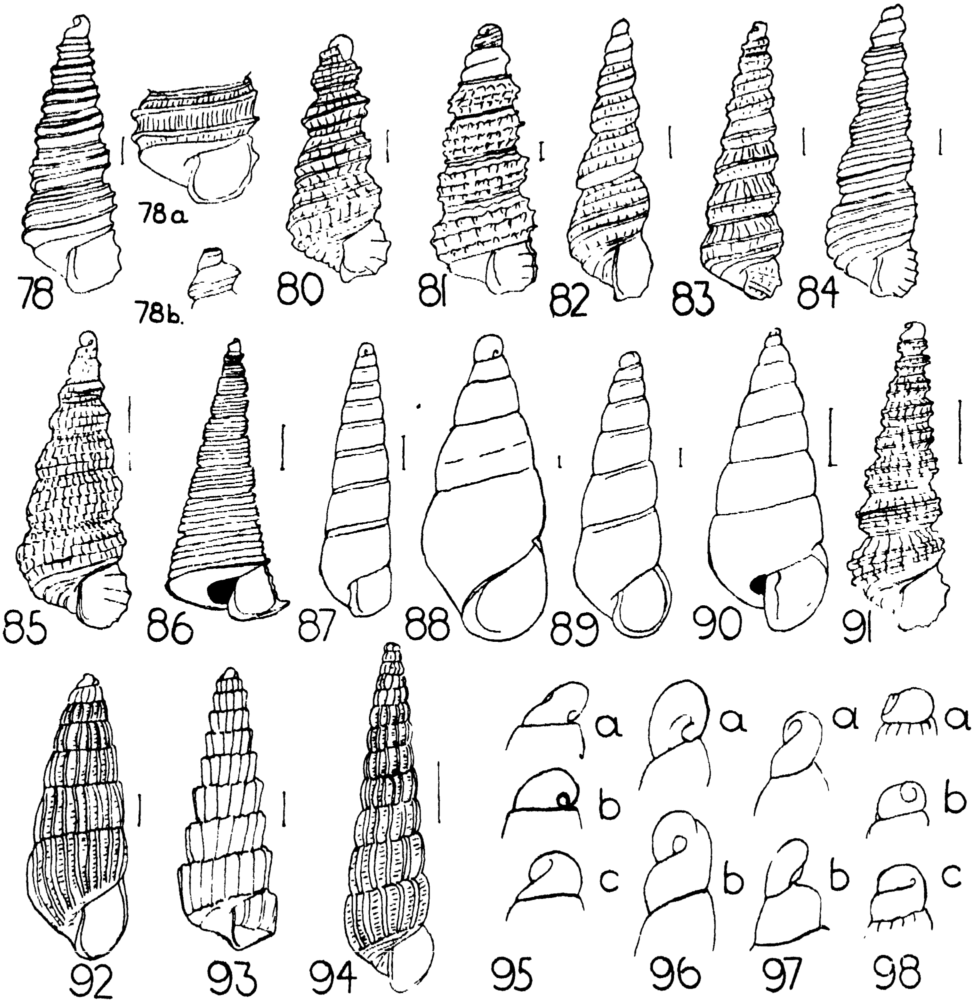
The specimen figured is from 30-35 fathoms off Crookhaven, and is 1·4 mm. in length.

Pseudorissoina elegans Hedley.

(Figure 89, after Hedley.)

Hedley 1068.

The type came from 110 fathoms off Cape Byron, and was 3·15 mm. in length.



Figures 78–98.

78, 79, *Eucharilda elegantula* Angas. 80, *Opimilda decorata* Hedley. 81, *O. protolineata* Laseron. 82, *O. porrigata* Laseron. 83, *O. fastigia* Laseron. 84, *Eucharilda pleurorbis* Laseron. 85, *Glyptozaria euglypta* Iredale. 86, *Charilda rosae* Hedley. 87, *Eulimella* (?) sp. 88, *Pseudorissoina exigua* Hedley. 89, *P. elegans* Hedley (after Hedley). 90, *Tiberia nitidula* Adams (after Hedley). 91, *Glyptozaria opulenta* Hedley. 92, *Pyrgiscus flexicosta* Laseron. 93, *Chemnitzia ambulatia* Laseron. 94, *Pyrgiscilla kitcheni* Laseron. 95 a, b, c, *Syrnola convexa* Laseron (protoconch). 96, a, b, *Eulimella hasta* Laseron (protoconch). 97, a, b, *Eulimella turrita* Petterd (protoconch). 98, a, b, c, *Chemnitzia mariae* Ten.-Woods (protoconch).

Pseudorissoina exserta, sp. nov.

(Figure 27.)

Shell of medium size, cylindrical, white, shining, semi-translucent. Protoconch indeterminate, only half a whorl visible, the remainder completely infolded in the apex. Mature whorls five, nearly flat, but bent in above to the sutures which are moderately indented. The sculpture is strong, consisting of prominent, broad, rounded, straight transverse ribs, about thirteen or fourteen on the body whorl, becoming obsolete on the base, which is smooth. Aperture pyriform, extended anteriorly, peristome complete, the inner margin well exserted from the body whorl, from which it is separated by a narrow umbilical slit, margins not reflected, no columella fold. Length, 3·6 mm.

Locality.—30–35 fathoms off Crookhaven.

Remarks.—This might well be taken for a *Rissoina* but for the completely infolded protoconch, which is a character possessed by some of the Pyramidellidae, but by none of the Rissoinas. The complete peristome and free aperture are very distinctive characters and fit in with the generic description of *Pseudorissoina* much better than the other local species assigned to that genus.

Genus **Tiberia** Monterosato.

Dall and Bartsch include *Tiberia* as a subgenus of *Pyramidella*, for small, white, cylindro-conical shells, smooth, and typically with two columella folds. Hedley allowed two species in his check list, but one of these is rejected for reasons given towards the end of this paper.

Tiberia nitidula Adams.

(Figure 90, after Hedley.)

Hedley 1042.

We have not seen this species, but Hedley recorded and figured it from 300 fathoms off Sydney, the specimen figured being 7 mm. in length.

UNFIGURED OR DOUBTFUL SPECIES.

Stylopsis pulchellus De Folin.

Hedley 1041.

This species was described in 1870 from a specimen given to de Folin by a friend, as from Port Jackson. It is hard to say in the absence of the type exactly what this shell is. It is minute, 2 mm. in length, the figure is rather poor, and from this and the description, we know of no Sydney shell with which it can be identified. It has four whorls, a heterotrophe protoconch, and may possibly be an immature *Turbonilla*. At the best it must be considered doubtful.

Tiberia pusilla jacksonensis Dall & Bartsch.

Hedley 1043.

This variety of the Japanese *T. pusilla* was described from two specimens in the Paetel collection labelled Port Jackson, Australia. There is no means of checking the accuracy of the locality, but as no shells of this type have since been found in New South Wales in spite of intensive collecting, it is probable that the locality was wrong and that the specimens really came from Japan. It is not likely to have been overlooked, for the shell is comparatively large, more than 6 mm. in length, and would be easily recognized by the two strong columella folds. I think that this species should be removed from the New South Wales list.

Turbonilla consanguinea Smith.
Turbonilla constricta Smith.
Turbonilla fischeri Smith.

Hedley 1046, 1047, 1048.

These three species were described as from 410 fathoms off Sydney, Station 164B of the "Challenger Collection". This is the station about which there has been so much controversy, as apparently some North Atlantic material was mixed with it. There is no reason to doubt, however, that these three species came from this locality, and that they will be rediscovered by future deep-sea dredging expeditions. In 1906, Hedley and Petterd, dredging 300 fathoms off Sydney, found about one-half of the disputed "Challenger" species, though none of the North Atlantic forms were among them. Amongst these was *Turbonilla constricta* (Hedley and Petterd, Rec. Aust. Mus., vi, 1906, p. 214). *Turbonilla constricta* is characterized by a broad base, and is constricted below the suture. In *T. fischeri* the ribs are of unequal width, and about one on every whorl approached the dimensions of a varix. The ribs in *consanguinea* are much finer than in *fischeri.* It is to be regretted that no material is available to illustrate these three species for this paper.

THE GENUS MATHILDA.

The genus *Mathilda* was proposed by Semper in 1865 for a group of Eocene fossils from the Mediterranean, and a number of recent eastern Australian species have been quite reasonably placed under it. There seems a definite relationship between the two groups, though widely separated both geographically and in time, a relationship which further emphasizes that many elements of the marine fauna of eastern and southern Australia are survivals of past geological periods. The Australian species of *Mathilda* seem individually also to have their counterparts in the European Eocene. Thus *Eucharilda elegantula* is close to *M. brocchii* Semper, *Mathildona euglypta* resembles *M. scabrella* Semper, and *Opimilda decorata* Hedley is close to *M. annulata* Semper.

The systematic position of the group is, however, very doubtful. Hedley in his Check List included *Mathilda* with the Acteonidae, but there seems little in common with such genera as *Acteon* and *Leucotina*. It is possible that the protoconchs of some species may be heterotrophe, but it is generally difficult to follow the coiling of the early embryonic stages, and so far no undoubted sinistral coiling has been observed. The general facies suggests a possible relationship with some of the Pyramidellidae, particularly *Cingulina*, but in the absence of any knowledge of the animal at all this is purely speculative. It is more probable that the group should constitute a family by itself but until more data is obtained I do not think this course is justified.

The question of new generic names for the Australian species is rather debatable, but modern usage is to split the larger genera into small groups, based on close rather than general relationship. For the New South Wales species Iredale proposed several new genera which are here used. Of these the introduction of *Charilda* for *Mathilda rosae* Hedley cannot be questioned, for this species is not only entirely unlike any of the other species, but may well belong to a different family. The new species have also been placed under Iredale's genera, though to be quite consistent still further new generic names could have been easily added. It is more important, however, to get the species listed, and correct genetic relationship is left for the future when more data are available.

Genus **Eucharilda** Iredale.

T. Iredale, Rec. Aust. Museum, 1929, xvii, p. 187.

Genotype, *Mathilda elegantula* Angas.

·Generic characters for *Eucharilda* as given by Iredale are the long spire, tilted turbinate apex, subplicate columella and lirate sculpture. This is fairly adequate, but it might be added that there is considerable resemblance to the local species of *Cingulina.*

Eucharilda elegantula Angas.

(Figures 78, 79.)

Hedley 1021.

Figure 78 is taken from an immature specimen from Pittwater 3·6 mm. in length, which shows the protoconch. Other specimens dredged in Pittwater are much larger and greatly elongated. Figure 79 shows the aperture, details of the sculpture, and the trace of a fold on the columella of a large specimen, with fourteen whorls, 14 mm. in length. The uppermost five or six whorls are missing, and perfect it would have been about 18 mm. in length. We also have it from reclamations at Tempe, Botany Bay, and its habitat is apparently moderately deep water with a muddy bottom.

Eucharilda pleurorbis, sp. nov.

(Figure 84.)

Shell small, elongately conical, colourless, thin, glassy and translucent. Protoconch globose and smooth, but it is possible that the initial whorl or whorls are infolded. Post nuclear whorls, six on the type, but a slightly larger but broken specimen suggests that the full number is seven or eight. The whorls increase regularly, are rounded, and greatly constricted at the sutures. Sculpture on the first whorl a single keel, on the second three spiral keels, increasing to five, and on the body whorl six. The keels are low, narrow, and rounded, but well-defined, with a secondary, very fine spiral thread between them. Transverse sculpture is present, but only visible microscopically, consisting of minute lines appearing here and there between the keels. Aperture sub-quadrate, anteriorly produced, the outer margin curved, thin and indented by the sculpture, inner margin nearly straight, and slightly reflected. Length, 3 mm.

Locality.—From shell sand, Manly Beach.

Remarks.—The only species with which this can be compared is *E. elegantula*, but it differs not only in size but in the greater number of spiral keels, which are also relatively narrower and have a secondary thread between them.

Genus **Opimilda** Iredale.

Rec. Aust. Mus., 1929, xvii, p. 187.

Genotype, *Mathilda decorata* Hedley.

Iredale gives no generic description of *Opimilda*, beyond remarking that the genotype is " a short, squat, perforate shell, quite dissimilar " (from *Eucharilda*). To say that it is perforate is hardly correct, though Hedley does mention an umbilical chink. Here we have included with the genotype other species in which, while the spiral sculpture is predominant, transverse sculpture is also well developed, and the surface is often cancellate.

Opimilda decorata Hedley.

(Figure 80, after Hedley.)

Hedley 1019.

The type came from 63–75 fathoms off Port Kembla, and was 4·25 mm. × 2 mm. It is thus an inhabitant of the continental shelf. The large protoconch, set at an angle on one side of the summit, and the regular cancellate sculpture should be easy recognition marks.

Opimilda protolineata, sp. nov.

(Figure 81.)

Shell minute, elongately conical, colourless, glassy and translucent. Protoconch, large, globose, tilted and microscopically spirally striate. Post-nuclear whorls five, increasing regularly, relatively short, rounded, constricted at the sutures. Sculpture on first post-nuclear whorl, a single indefinite keel, on the second two, then three, and four on the body whorl. A narrow, plain, raised keel is also present on the suture. The lowermost keel on the body whorl borders the base which is excavate. The main keels are narrow, sharp and raised, and broken by undulations into raised tubercles, which are arranged vertically into rows, about fifteen on the body whorl, giving the appearance of transverse sculpture. Aperture well produced anteriorly, quadrate, the outer margin indented by the sculpture, the inner margin reflected. Length, 2 mm.

Locality.—Manly Beach, from shell sand.

Remarks.—Though the single specimen may not be quite mature, it is so utterly unlike any other species that I have no hesitation in giving it specific rank. The striated protoconch, peculiar sculpture and excavate base are distinctive characters which should aid its future recognition.

Opimilda porrigata, sp. nov.

(Figure 82.)

Shell of medium size, elongately conical, pale yellowish-brown, solid. Protoconch globose, but details not visible. Post-nuclear whorls five, elongated, slightly angled, constricted at the sutures. Sculpture predominantly spiral, on the first whorl a single keel, on the second and third whorls two, then three, and on the body whorl three with subsidiary keels above. The cross sculpture rather irregular, consisting of widely-spaced thin lines, mainly between the keels, but occasionally producing a slight nodulation on the keels themselves. Aperture quadrate, its longest axis vertical, and greatly extended anteriorly, outer lip indented by the sculpture, inner lip reflected and nearly straight. Length, 4 mm.

Locality.—8-10 fathoms off Point Halliday, North Coast.

Remarks.—Once again this species is unlike anything yet described from the Australian coast. The elongated whorls, sculpture and extended aperture should aid in its future recognition.

Opimilda fastigia, sp. nov.

(Figure 83.)

Shell small, elongately conical, colourless and translucent. Protoconch globose and tilted. Extreme apex apparently infolded. Mature whorls eight, short, increasing regularly, contracted at the sutures. Sculpture predominantly spiral, the earlier whorls angulated by one keel, which remains predominant, though other minor keels appear below it, particularly on the body whorl. Transverse sculpture conspicuous, particularly on the upper portion of the whorls, where it appears as rounded ribs which, as they cross the keels, rise into nodules. Aperture roughly pentagonal, the outer margin forming two sides of the pentagon, and indented by the sculpture; inner margin straight and not reflected. Length, 3·2 mm.

Locality.—Port Stephens, shell sand.

Remarks.—Once again the characters of this species do not lend themselves to comparison with any other, and it is a beautiful and distinctive little shell. The many whorls, and distinctive sculpture should render future recognition easy.

Genus **Glyptozaria** Iredale.

Proc. Linn. Soc. N.S.W., xlix, 1924, p. 248. Syn. *Mathildona* Iredale, Rec. Aust. Mus., xvii, 1929.

Iredale proposed the genus *Mathildona* for large shells from the continental shelf, which he remarked came very close to the original *Mathilda* Semper. He states that the genotype, *M. euglypta* Iredale, " differs in the form of the protoconch, and Cossmann has separated the Palaearctic fossils into groups by means of this feature, so that it is necessary to avoid confusion to designate the Austral groups also." The protoconch of *Mathildona* is described as "anastrophic, tilted, slightly immersed by succeeding whorls, smooth." Other points that may be noted are that the shell is large, 20 mm. or more, solid, many-whorled, and with cancellate sculpture.

Previous to this paper, Iredale had proposed the genus *Glyptozaria* for Hedley's *Turritella opulenta*, merely stating that it differs from other Australian Turritellas by the absence of a sinus in the outer lip. I do not think that this shell has any connection with the Turritellidae at all, and comparison with Iredale's species *euglypta* (see Figures 85 and 90) at once suggests that they are very close together and are co-generic. As *Glyptozaria* was published five years earlier it will therefore have priority over *Mathildona.*

Glyptozaria euglypta Iredale.

(Figure 85.)

Rec. Aust. Mus., xvii, 1929, p. 186, Pl. xl, Fig. 6.

The specimen figured is from 30-35 fathoms off Crookhaven, and is smaller than the type from 50-60 fathoms off Montague Island, being 13 mm. in length instead of 20 mm., and with one fewer whorl. The large size and beautiful cancellate sculpture are good recognition points.

Glyptozaria opulenta Hedley.

(Figure 91.)

Hedley 594. (*Turritella.*)

The generic position of the curious shell which Hedley called *Turritella opulenta* has always been open to doubt. Beyond its elongated shape it has little in common with *Turritella* as generally defined. The tilted helicoid protoconch suggests the group of the Mathildas and actually it is very close to Iredale's *Mathildona euglypta*, with very similar sculpture and with a similar aperture. I should say these two were undoubtedly cogeneric, but *opulenta* is narrower, smaller, and differs in the detail of the sculpture. It is fairly common on the continental shelf, the specimen figured coming from 30–35 fathoms off Crookhaven, and being 7 mm. in length.

Genus **Charilda** Iredale.

Rec. Aust. Mus., xvii, 1929, p. 187.

Genotype, *Mathilda rosae* Hedley.

Here there can be no doubt as to the need for generic separation, as the genotype stands out from all other Australian shells. The protoconch is typically that of the Pyramidellidae, the spire is long and gradually spreading so that it has a concave contour, the base is sharply truncate and deeply umbilicate, the aperture is semi-circular, with the outer margin flat with the lowermost keel extended as a prominent projection, and the sculpture consists of numerous regular spiral keels with no transverse sculpture.

Charilda rosae Hedley.

(Figure 86.)

Hedley 1020.

This is a fairly common species in shell sand on the outer beaches, and may be easily recognized by the characters mentioned in the generic description. The specimen figured came from Port Stephens and is 5·5 mm. in length.

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NOTES ON THE NEW SOUTH WALES MITRAS WITH SPECIAL REFERENCE TO THEIR PROTOCONCHS.

By Charles F. Laseron, F.R.Z.S.
Honorary Correspondent, Australian Museum.

(Figures 1–11.)

Introduction.

The late Charles Hedley (1918) allowed twelve species of *Mitra* as occurring in New South Wales.

These were: 892 *Mitra acromialis* Hedley, 893 *M. carbonaria* Swainson, 894 *M. cookii* Sowerby, 895 *M. glabra* Swainson, 896 *M. legrandi* Ten.-Woods, 897 *M. miranda* Smith, 898 *M. nodostaminea* Hedley, 899 *M. pacifica* Reeve, 900 *M. rhodia* Reeve, 901 *M. solida* Reeve, 902 *M. strangei* Angas, and 903 *M. volucra* Hedley.

Two additional species were described and named by T. Iredale (1929) from the "Triton" dredgings in Sydney Harbour. These were *Chrysame lemma* (p. 343, pl. xxxviii, figure 6) and *Mitropifex quasillus* (p. 346, pl. xxxviii, figure 18).

These species still stand, though there has been some revision in their names. This paper now raises the list of species to twenty-three by the addition of four new species, and five species now recorded from New South Wales for the first time. The four new species are *Mitra sinusigera* Laseron, *M. tasmantis* Laseron, *M. jervisensis* Laseron, and *M. cericosta* Laseron.

Those recorded for the first time are *Mitra eximia* Adams, *M. peregra* Reeve, *M. tuberosa* Reeve, *M. lugubris* Swainson, and *M. scutulata* Lamarck.

Apart from zoological classification, but curiously enough broadly paralleling it, these twenty-three species may be divided into groups based on distribution. Firstly there are six tropical species, representing an overlap into the Neoperonian region, all recorded from the north coast of New South Wales, and introduced no doubt by the warm Notonectian current. These are *pacifica*, *peregra*, *tuberosa*, *lugubris*, *eximia*, and *scutulata*.

The next group includes the species inhabiting the foreshores, or occurring just below low tide. Some of these have a limited geographical range, others occur widely distributed along the coast. They include the brown Mitras, separated by Iredale in *Vicimitra*. They are *contermina* Iredale replacing *carbonaria*, *cookii*, *exposita* Iredale replacing *glabra*, *rhodia*, *prosphora* Iredale replacing *solida*, *volucra*, and the new species *sinusigera*.

The final group includes the deep-water species, sometimes found dredged within the harbours, but mainly inhabiting the continental shelf. Most of these are heavily sculptured, and are generally akin to species found in similar locations in Tasmanian waters. The species are *acromialis*, *legrandi*, *miranda*, *nodostaminea*, *strangei*, *lemma*, *quasillus*, *tasmantis*, *jervisensis*, and *cericosta*. It is probable that the genetic relationship of some of these species must be looked for in the past rather than in other zoogeographical provinces, and will be found in the Cainozoic rocks of New Zealand and southern Australia, or in other parts of the world.

The Mitra Protoconch.

Though the single genus *Mitra* is here used, it is not suggested that the group is monogenetic, for undoubtedly many genera exist, but it is felt that any revised classification should be based on a wider geographical field, and that characters other than taxonomic must be considered if true genetic relationship is to be established. There has been a good deal of work abroad on the Mitra radula, and considerable differences exist in this character in different species, but so far little work has been done on the radula of the eastern Australian species, and until there is information in this direction, it is well to resist the temptation to propose new genera locally. As more than 800 species have so far been described, mainly from the Pacific and Indian Oceans, the problem is certainly a world-wide rather than a local one. In fact many writers consider that the group is not only heterogeneous, but that more than one family is represented.

In New South Wales, Hedley figured the radula of *Mitra rhodia* (1917, p. 711, figure 16). Cooke also described the radula of *rhodia* from Sydney Harbour, and showed the rhachidium to have five, not four cusps as illustrated by Hedley. In view of the previous confusion as to the identity of these brown Mitras, it is not certain what particular species he studied. Iredale's genus *Vicimitra* was introduced on the basis of a radula figured by Cooke as from *Mitra solida*, and Iredale also included *contermina* and *exposita* in his new genus, but so far the radulae of these species are undetermined, and there seems no other reason why they should be so included.

Of characters other than the radula, the protoconch would seem to have great possibilities in establishing genetic if not phylogenetic relationship. In many other groups writers have used it as a basis of classification. Hedley used it in his monograph on the Turridae, it has been used in *Mathilda*, in the Pyramidellidae, the Rissoidae, the Volutes and other families. Its value for phylogenetic purposes is, however, open to considerable doubt.

It is generally recognized that origins persist in the embryology of animals, and this is the argument used by advocates of the protoconch for purposes of classification. But is the protoconch truly embryonic ? Where embryonic characters show ancestral origins it rarely happens that they have any relation to a creature's present environment, and thus they play no part in its normal functions. As maturity develops they become obsolete and rudimentary and often disappear entirely.

With this in mind consider the protoconch generally and the *sinusigera* protoconch particularly. In a series of papers read before the Linnean Society of New South Wales, from 1902 to 1912, Dr. H. L. Kesteven described the protoconchs of various local shells, and recorded a *sinusigera* protoconch from the common *Thais*. In the earliest paper he thought this type was peculiar to *Thais*, but later recognized that it is found in many families. Iredale (1911) found a juvenile *Mitra* in the Kermadecs with a *sinusigera* apex, and reviewing the question at length, pointed out that in the oceanic islands it occurs in widely diverse families, and is generally characteristic of a free-swimming larval stage. In his paper Iredale forecast its importance, and suggested that where the type of protoconch differed, the difference must be genetic but not phylogenetic. Kesteven (1912) admitted a specific difference alone, except where other characters are considered. He considered that the protoconch is not embryonic, that the real embryonic stage of the shell occurred before the protoconch developed, and it is in this initial stage that both phylogenetic and genetic origins must be sought.

The *sinusigera* protoconch bears this argument out. Its association with a free-swimming larval stage shows it to be a definite factor in the animal's present existence. It is found in gasteropods of widely different families, yet it does not occur in all the species of groups which are otherwise very closely related. For instance, the protoconchs of *Thais neglecta* and of *Mitra sinusigera* resemble each other very closely, yet it would hardly be suggested that these two species should be grouped together. Following this argument to its logical conclusion, it would seem that if the *sinusigera* protoconch is ancestral, it has only persisted in those species of particular groups in which it is necessary to their normal development, while in allied forms it has become entirely obsolete. As a major feature of classification it would therefore link many families in a remote past. If this be admitted, it is logical to admit that the same importance must be given to protoconchs of other types, a course which in many families would create the utmost confusion and would be in disagreement with all other characters.

Nevertheless it is well at this stage not to be too dogmatic, for though as a whole the various types of protoconch may represent parallel development in different groups, in some they may have become so persistent as to constitute a family characteristic, as for instance in the heterotrophe protoconch of the Pyramidellidae. It is probable, however, that for the most part the true embryonic shell of the gasteropod is, as stated by Kesteven, absorbed in the protoconch or is cast before the secretion of the protoconch begins.

There can be no doubt as to the specific value of the protoconch, and it can be laid down that whenever the protoconch differs, different species are indicated. At times it may have genetic value. In this paper the protoconchs of as many species as possible are described and, combined with other characters, they certainly suggest relationship between some of the species. For instance, *contermina*, *rhodia* and *exposita* have very similar protoconchs, and are also closely related in shell characters. This group might easily be raised to subgeneric or even generic status. At the same time it is impossible to include them in Iredale's *Vicimitra*, with the type species of which they have nothing more in common than they have with other species of *Mitra*. *Mitra sinusigera*, on shell characters, would seem to be closely allied to the *rhodia* group, but on the protoconch alone would be widely separated. So also would *cookii*, which again has an entirely different type of protoconch. Further discussion on this point is deferred, but will be mentioned again in the main body of this paper when individual species are considered.

NOTES ON THE SPECIES.

Mitra rhodia Reeve.

(Figures 1, 1*a*.)

Hedley 900.

The small group of shallow water Mitras, which might be collectively referred to as the " Brown Mitras " has been the subject of considerable confusion. Many references appear in literature under a multiplicity of names, such as *carbonaria*, *glabra*, *badia*, *digna*, *pygmaea*, *cookii*, *rhodia* and others, many of which have already been discarded by previous writers, either as synonyms, or as applicable to different species from other localities.

Hedley (1918) in his Check List allowed *carbonaria*, *cookii*, *glabra*, *rhodia* and *solida* in this group. He rejected *badia* Reeve as the young of *carbonaria*, but allowed *rhodia* by the same author. Since that date Iredale (1929, p. 343) has rejected *solida*, *carbonaria* and *glabra*, proposing a new genus for *solida*, which he names *Vicimitra prosphora*, and substituting *Vicimitra contermina* and *exposita* as new species to replace *carbonaria* and *glabra* respectively. He considered *carbonaria* to be the Tasmanian shell. It is proposed to accept *contermina* without comment, as lack of access to good Tasmanian material precludes comparison, and there can be no doubt of the identity of the large New South Wales species under Iredale's name. The same applies to *exposita*, and *cookii* is a well-defined species.

Mitra rhodia and *badia* were both described by Reeve (1845). Unfortunately the original descriptions and illustrations are very unsatisfactory for identification; moreover, the locality of the types is given as unknown. When Hedley visited London in 1912, he examined shells which were labelled as the types of these species, both from Sydney, that of *rhodia* being described as living under stones in Sydney Harbour. When the Cuming Collection, on which Reeve worked, was presented to the British Museum, a great deal of guesswork was apparently used in identifying the types of his species. In view of the fact that Reeve, who had the reputation of being a very methodical worker, gave no locality for his types, it is not certain that these particular specimens are those on which he based his species, and therefore we are thrown back on his written work only. His description of *rhodia* is as follows:

"Mitra rhodia:—The Rose-wood Mitre—Shell elongated, spire acuminate, rather smooth, transversely very finely striated, very dark brown, columella three-plaited, aperture short. Hab. ——— ?" (1845, Pl. 28, f. 225.)

This description, inadequate though it is, fits the common Sydney shell, and though the type locality is uncertain, long usage justifies the retention of Reeve's name. In order to clarify the position, the following fuller description is given, based on specimens from Shark Island, Port Jackson.

Shell conically acuminate, solid, colour dark brown, nearly black, occasionally red-brown, particularly from the outer beaches, with a narrow orange band just below the periphery, the colour fading on beach specimens to yellow brown. Protoconch of three whorls, the first flattened, the second and third globose, the whole dome-shaped and smooth. Adult whorls six, the first with faint, punctate, spiral striae, becoming slightly stronger in succeeding whorls, and persisting thus to the body whorl. Whorls slightly rounded, the body whorl slightly restricted at the base. Aperture about two-fifths of total length, acute posteriorly, rounded anteriorly, with a short, rounded canal. Inner margin regularly and slightly curved, with a narrow glazed band. Columella plaits two in the early stages, increasing to three, with suggestions of a fourth in very old specimens, thick, rounded and very oblique, the posterior the most prominent.

Dimensions.—Length, 24 mm., width, 8 mm. The largest specimen seen measured 27 mm., and this seems to be nearly the maximum size. A few specimens are relatively broader.

Habitat.—Between tide marks, under stones, but particularly abundant in beds of the common mussel, *Brachyodontes hirsutus*, at Shark Island, North Harbour, and other localities within Port Jackson, also at Long Reef and other outer reefs along the coast. On the north coast, this is replaced by *M. cookii* and *contermina* as the common species.

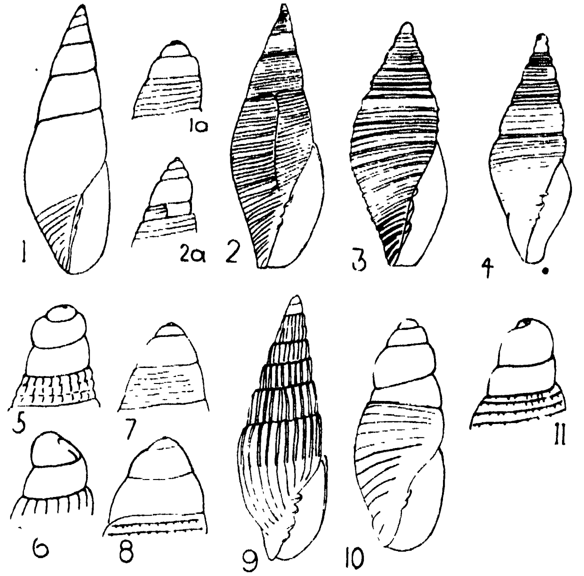
Mitra (Vicimitra) contermina Iredale.

(Figure 8.)

This is the largest of the New South Wales species, sometimes attaining a length of 3 inches. Immature specimens are sometimes confused with *M. rhodia*, but there should be no real difficulty in separating the species. Half-grown specimens of *contermina* have fewer and larger whorls, are broader, and have two to three thin columella plaits; the aperture is thinner with practically no glaze on the inner margin. The plaits increase from two in young specimens to five in the fully mature state. They are always conspicuously thin.

The protoconch has not previously been recorded. It is of three whorls, dome-shaped, dark brown, smooth and glossy, the first whorl minute, the next two increasing rapidly. Sculpture appears on the fourth whorl as radial punctate striae, and attains its maximum development on the third adult whorl. Beach specimens are invariably quite smooth, as the sculpture is very superficial and soon disappears with rolling. The last whorls of the adult shell increase very rapidly, the aperture is large and is practically half the total length of the shell. In very old specimens the shell is greatly thickened, and the outer margin of the aperture is flattened and even sinuate. There seem to be two forms, which may be sexual, one very much broader than the other.

The habitat of *M. contermina* is the outer reefs, though it occasionally comes into the mouths of the harbours. It lives in a slightly deeper zone than *rhodia*, and may be procured under stones just below low tide or in the deeper pools. It breeds in the late winter; the egg clusters are attached to the rocks, but details have not been observed. It ranges right along the coast, but is particularly abundant on the North Coast.



Figures 1–11.

1, 1*a*. *Mitra rhodia* Reeve. 2, 2*a*. *Mitra sinusigera* Laseron. 3. *Mitra tasmantis* Laseron. 4. *Mitra jervisensis* Laseron. 5. *Mitra cookii* Sowerby (protoconch). 6. *Mitra volucra* Hedley (protoconch). 7. *Mitra exposita* Iredale (protoconch). 8. *Mitra contermina* Iredale (protoconch). 9. *Mitra cericosta* Laseron. 10. *Mitra* sp. (protoconch) 11. *Mitra* (*Vicimitra*) *prosphora* Iredale (protoconch).

Mitra (Vicimitra) exposita Iredale.

(Figure 7.)

This species is occasionally taken alive at Long Reef, but invariably from below low water at spring tides. It would seem to inhabit slightly deeper water than its allied species, and thus the three species, *rhodia*, *contermina* and *exposita* are zoned in habitat, *rhodia* between tide marks, *contermina* at or below low tide, and *exposita* below this.

No live juveniles with protoconchs have been obtained, but amongst a number of *Mitra* tips collected by the late C. Hedley from Middle Harbour, is one with the protoconch attached to two mature whorls, which is recognizable as this species. The whole is dome-shaped, of three whorls, the first minute, the second and third expanding rapidly, brown and glossy. Sculpture appears first on the fourth whorl as numerous radial, faint, punctate lines, increasing until on the third, adult whorl they attain their maximum. The colour of the adult whorls is lighter than the protoconch and remains so at all stages.

Even in young specimens the straight-sided whorls are a distinctive feature, and the adult shell is much longer with a shorter aperture than the other allied species.

Mitra sinusigera, sp. nov.

(Figures 2, 2*a*.)

Shells smaller than other brown Mitras, bi-conical, dark brown, with faint broken patches of yellow below the suture. Protoconch sinusigera, of four and a half whorls, inclined and tilted at a considerable angle, colour bright yellow, smooth and glossy. Initial whorl dome-shaped, the next three expanding rapidly, the fifth overlapped by the first adult whorl, from which it is separated by a slight varix, curving backwards. Just before this stage a few undulations appear. On one specimen is what appears to be a trace of the sinusigera spur, but this generally is overlapped and hidden by the beginning of the adult shell.

Adult whorls five, with nearly flattened sides, the body whorl large and expanded. Sculpture appears on the first adult whorl as three broad radial ridges, increasing to five on the succeeding whorl. The transverse sculpture first appears as fine indentations between the radials, and later overriding them, but the radials are always predominant. The sculpture, though fine throughout, is more prominent in the mature shell, particularly on the base of the body whorl. The aperture is almost half the length of the adult shell, the outer margin expanded, canal short and truncate, inner margin with four thin columella plications, oblique and rounded.

Dimensions: Length, 17 mm., width, 6·5 mm.

Habitat.—Outer reefs, below stones at low tide. Long Reef, Collaroy (type); Twofold Bay (Roy Bell Collection); and a single tip from 25–30 fathoms off Crookhaven.

Remarks.—This was at first taken for the young of *M. contermina* which it greatly resembles, but the protoconch of course indicates something quite different. It is probable that it is much commoner than at first apparent, and that many beach specimens taken for *contermina* are this species which, without the protoconch, is practically indistinguishable.

The discovery of a sinusigera protoconch in a New South Wales *Mitra* is of considerable interest, and its wider implications have already been discussed in the Introduction to this paper.

An unidentified protoconch, which shows some similarity to that of *M. sinusigera*, is here figured for purposes of future reference (Figure 10). The specimen is of a juvenile *Mitra*, with one adult whorl, from shell sand, Port Stephens. The protoconch is four whorled, glassy and globose, tilted at an angle, the last whorl at an angle and half immersed in the adult whorl. The junction of the protoconch is marked by a slight varix, but the presence of the spur could not be detected owing to the overlap of the adult shell. The initial sculpture consists of faint radials, crossed by growth lines, and suggests that the ultimate mature shell will be smooth and pale-coloured.

Mitra cookii Sowerby.

(Figure 5.)

So far I have not seen this species alive, but it is very common on the beaches of the North Coast, where it replaces *rhodia* as the common species. When dredging at Point Halliday, a few miles to the south of the Manning River, a number of *Mitra* tips were taken in from 8–10 fathoms about a mile from the shore. At the time these could not be identified with any adult species, but later two specimens of half-grown *cookii* found on the beach showed the protoconch sufficiently to link them with those dredged. As this protoconch has not been previously recognized, the following description is given:

It consists of three whorls, the first small and dome-shaped, the second large and globose, the third smaller, and overlapped by the first adult whorl, so much so that it is nearly invisible on some specimens. There is a slight but distinct varix separating the adult sculpture. All three whorls are smooth, white and glassy. The first adult whorl is narrow, white, with three spiral keels, broken by transverse punctures. These become stronger in the succeeding whorl, which is yellow, and thence the sculpture becomes less marked and the colour deepens.

In the adult stage, the chocolate colour, white band, and splashed white markings make this species easily recognizable.

Mitra volucra Hedley.

(Figure 6.)

Amongst the dredgings from Point Halliday were two juvenile *Mitra*, sufficiently developed to link them with *M. volucra*, which is not uncommon on the nieghbouring coast. The original description was from three specimens without tips collected by myself from Woolgoolga, about 100 miles further north, and this opportunity is taken to describe the protoconch, hitherto unknown.

It consists of two whorls, the first large and rounded and tilted at an acute angle, with possibly an initial whorl infolded and hidden, the second whorl slightly rounded, its axis normal with the adult shell, and partially enveloping the first whorl of the protoconch. The first adult whorl with a distinct shelf, its sculpture consisting of about eighteen transverse rounded ribs, which later become obsolescent. The colour of the protoconch is brown, that of the juvenile brown, mottled with white.

The range of *M. volucra* is approximately from the Clarence to the Manning Rivers, where it is the common shore species associated with *M. cookii.*

Mitra (Vicimitra) prosphora Iredale.

(Figure 11.)

This species is common on the beaches of the North Coast, and in Port Jackson on a sandy bottom, from 6–9 fathoms, Sow and Pigs Reef, Port Jackson. The protoconch, hitherto undescribed, is rather peg-like, the first whorl inflated, apparently infolded at the tip, the second regular, both smooth and white. The first mature whorl has strong radial punctate striae, which are prominent on the first three mature whorls; thence the shell is almost smooth.

Mitra tasmantis, sp. nov.

(Figure 3.)

Shell small, bi-conical, grey to white. Protoconch rather peg-like, of a single naticoid whorl. Mature whorls five, increasing regularly, slightly rounded, body whorl large and inflated, about two-thirds total length of shell, sutures slightly impressed. Sculpture predominantly spiral, on the first adult whorl faint spiral striae, then on each whorl four regular, equally-spaced, rounded keels. On the body whorl, the keels are of two orders: just below the suture are three fine spiral striae, thence the main keels alternate with single fine striae right to the base. Transverse sculpture is also present, more prominent in the early whorls and obsolete on the base. It consists of fine transverse ridges, between the keels, but not overriding them, except on the secondary keels on the body whorl, which are raised into minute, rounded tubercles. Outer margin of aperture rounded, acuminate posteriorly, truncate anteriorly, columella with a thin band of callus, plaits three, large, solid, and very oblique.

Dimensions: Length, 10·5 mm., breadth, 4 mm.

Localities.—50–70 fathoms, Twofold Bay (collected by Roy Bell, type); 6–9 fathoms, Sow and Pigs Reef.

Remarks.—In general form this species resembles *M. tasmanica* Ten.-Woods, but has very different sculpture, which separates it at once from all other Australian Mitras.

Mitra jervisensis, sp. nov.

(Figure 4.)

Shell small, bi-conical, whitish, flecked with brown. Protoconch a single inflated naticoid whorl. Mature whorls six, increasing regularly, slightly rounded, sutures slightly impressed, body whorl large, about half the total length of shell, its greatest diameter below the suture, tapering anteriorly. Sculpture predominantly spiral, the earlier whorls nearly smooth, consisting of finely incised channels, about six to the penultimate whorl, the uppermost rather deeper than the others, making a distinct band just below the suture. The sculpture persists to the base, where, however, it is less prominent. Transverse sculpture present, but not prominent, consisting of fine growth lines. Aperture narrow, outer margin rounded, bent in sharply anteriorly, inner margin nearly straight. Columella plaits four, prominent but thin, transverse.

Dimensions.—Length, 11 mm., breadth, 4·2 mm., aperture, 5 mm.

Localities.—15 fathoms, Jervis Bay (type), also one immature specimen; 25 fathoms off Bateman's Bay; on beach, Jervis Bay (Miss G. Thornley).

Remarks.—The regular bi-conical shape, four columella plaits, and distinctive sculpture, should ensure future recognition of this species. I know of no other Australian species with which it could be easily confused.

Mitra cericosta, sp. nov.

(Figure 9.)

Shell small, elongate conical, greyish-white. Protoconch of two whorls, the first dome-shaped, the second even, merging into the adult shell. Mature whorls six, increasing regularly, with a narrow shelf at the sutures, body whorl nearly half the total length. Sculpture predominantly transverse, consisting of numerous straight rounded costae, about twenty-six on the penultimate whorl, about equal in width to the inter-costal spaces. The main costae terminate abruptly at the periphery, but continue in an attenuated form as thin lines right to the base. Spiral sculpture present, but only visible microscopically, when it appears as numerous fine lines, between and even overriding the costae, particularly in the earlier whorls. Aperture comparatively short and wide, outer margin curved, inner margin arcuate, columella plaits four, prominent, transverse.

Dimensions : Length, 15 mm., breadth, 5 mm., aperture, 6 mm.

Localities.—30–35 fathoms off Crookhaven.

Remarks.—This species is probably allied to a group of Tasmanian deep water Mitras, centring around *M. pumilio* May, all characterized by four columella plaits and prominent transverse sculpture. It differs from all, however, by its more elongate form, and much more numerous costae.

Mitra strangei Angas.

Hedley 902.

May 787.

This species was taken alive in 15 fathoms on a sandy bottom between Port Jackson Heads.

The protoconch is of two whorls, the first dome-shaped, comparatively large, the second showing traces of incipient sculpture. The third shows prominent sculpture finer, but similar to the adult shell. The animal is a very pale yellow, almost white, with a long, narrow foot, truncate in front. The tentacles are widely spaced, short, with small, black eyes about half-way to the tip. The siphon as seen was short, but as with other species was extendable to a much greater length.

Superficially at least, the animals of the Mitras present very few characters which can be used in their description. Hedley (1917, p. 711, Pl. xliii, Figures 15, 16) described the animal of *M. rhodia.* In all essentials his description is similar to the above, and applies very nearly to other local species. If the soft parts are to be used taxonomically differences will have to be sought in anatomical characters, particularly the radula.

In the Tasmanian list, May figures a strongly cancellate species as *strangei,* and this is evidently something different, probably *nodostaminea* of Hedley. Angas's description and figure are very good and show the spiral sculpture to consist of fine ridges which are predominant, but are crossed by very fine transverse lines. The type locality is "dredged, Middle Harbour", and our specimens from nearby match very well.

Mitra pacifica Reeve; **M. eximia** Adams; **M. tuberosa** Reeve; **M. lugubris** Swainson; **M. peregra** Reeve; **M. scutulata** Lamarck.

These six species, all collected at Woolgoolga on the North Coast, were kindly identified for me by Mrs. L. H. Woolacott from material in the Australian Museum. Only one, *M. pacifica*, is on Hedley's Check List, and the other five are, therefore, new additions to the New South Wales fauna. All are tropical species, and are more typical of the Queensland fauna. They may be looked upon as the overlap of the two faunas, and as casual visitors brought down in a larval form or on driftwood by the strong warm Notonectian Current which sweeps down the coast. Other tropical species, too worn for identification, have also been seen from this locality, also from Angowrie, slightly more to the north. No doubt many more will be recorded in the future.

It is as yet impossible to say to what extent these visitants have become permanently established in the area, what part they have in local ecology, and how far they may be looked on as a definite element in the Neoperonian Faunal Province. It would seem desirable in compiling check lists that such tropical invaders should be retained in a separate list, for the present at least, until such time as their place in the natural economy is revealed. This applies not only to Mitras but to many species in other families of tropical shells.

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SOME NEW AND UNUSUAL STONE IMPLEMENTS FROM AUSTRALIA AND NEW GUINEA.

By FREDERICK D. McCARTHY.

Curator of Anthropology, Australian Museum.

(Figures 1–21.)

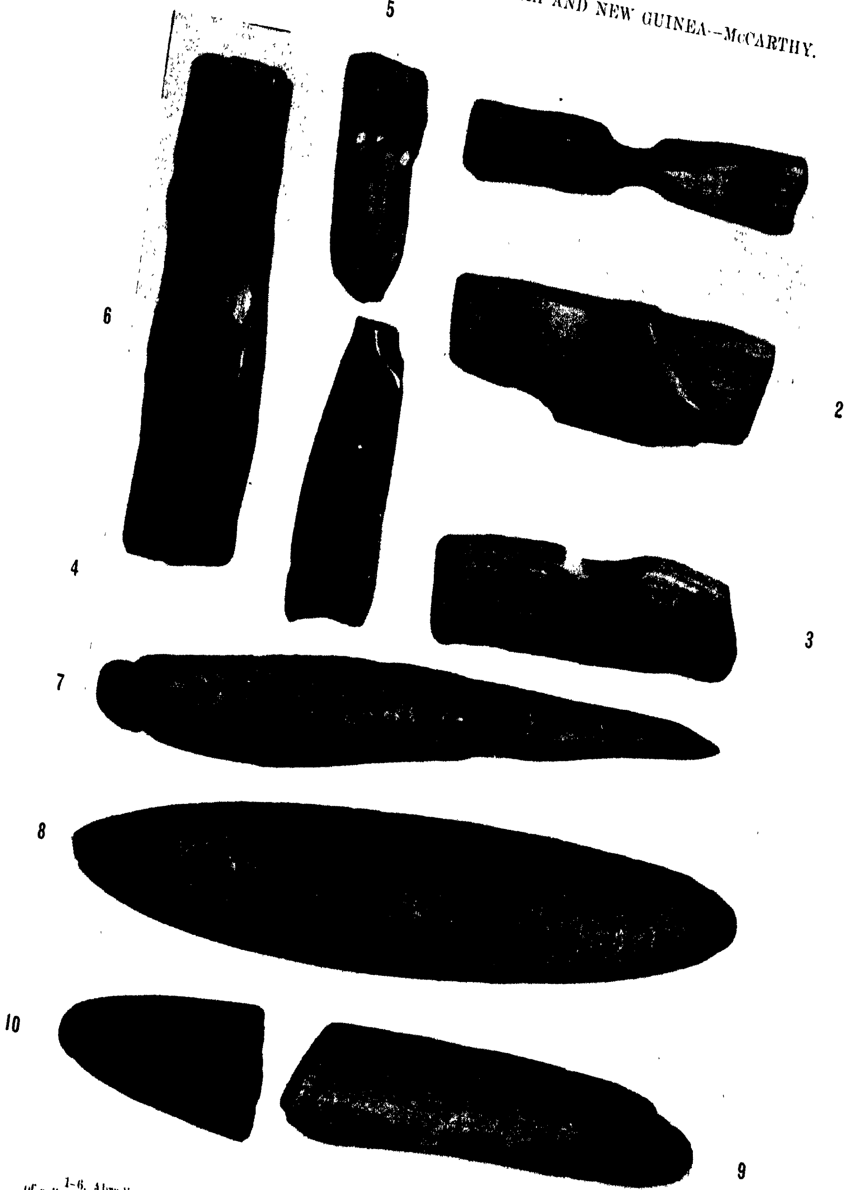
ABRADING STONES.

Morella-type. During 1949 Mr. Duncan Mackay of Hereward Station, Morella, central Queensland, presented to the Museum a series of twelve complete and several imperfect specimens of a type of abrading stone not previously recorded in Australia. They were found in widely scattered places in the district, which is part of the Darling Downs, mostly near creeks and on claypans, but some were collected on hills some miles away from permanent water. One of the claypans yielded almost a dozen specimens. There is no evidence to suggest that they were produced by natural agencies, in fact, the polishing on them is obviously artificial.

They are all flat-sided pieces of silicified wood, mostly rectangular in transverse section, but some are plano-convex, oval, lozenge and triangular in section. Silicified wood is abundant in the district.

E.53229.1 (Figure 1) bears the greatest amount of use on its numerous polished surfaces, which are separated by sharp ridges. It is 10·2 × 2 × 1·8 cm., almost square in section, and the lower surface is flat with a deep groove in the middle; the opposite surface is flat at one end on which there is a very shallow groove, there is a deep groove in the middle, and the other end is ridged. One lateral margin or side is flat at one end which bears a very shallow groove, there is a second shallow groove in the middle, then a hump, and a third shallow groove at the other end adjoining a narrow grooved facet on its margin; the opposite side has a bevelled surface along each margin, between which is a flat face at each end, and a sharp ridge (between the grooves) in the middle. All of these surfaces are highly polished, and they bear in all eight grooves from some just begun to two almost 4 mm. deep. The grooves are from 1·6 to 2 cm. wide, and the deepest two are situated approximately in the middle of the lower and upper surfaces but not directly opposite one another.

E.53229.2–4 (Figures 2 3, 6) are three other well-used specimens of a similar type, 9 × 2·5 × 2, 9·3 × 3·5 × 1·5, and 11·5 × 3·4 × 1·8 cm. The largest one has broad upper and lower surfaces on each of which is a deep groove; these grooves are opposite one another, are closer to one end than the other, and are from 2 to 3 cm. wide. The grooves on both surfaces are formed by a narrow bevelled groove at each end and then a wider groove extending to the middle, there being two opposite narrow pairs and two opposite wide pairs of facets forming an encircling groove. The narrow pairs are separated by a narrow flat strip of unused cortex on each lateral margin. The surface is rough and ridged and the polishing extends from the groove at one end and halfway to the other end on one surface, and partly along the ridges on the other surface. One lateral margin is lightly polished from end to end, with the beginnings of a groove on each end, and the opposite side has the beginnings of a groove at one end. The second specimen has six grooves, among which two depressions form the groove on one broad flat surface, and the beginnings of the groove on the opposite surface; one lateral margin has two narrow bevelled grooves 2·5 and 4 cm. long, separated by a median ridge, and the opposite side has narrow grooves also. The third specimen has five grooves, four of which form an encircling groove closer to one end than the other. On one broad flat surface the groove is 3 cm. wide and 4 mm. deep, but the opposite groove is not so deep, and adjoins an



Figures 1–10.

1–6, Abrading stones of the *Morella*-type, made of silicified wood, from Morella, Queensland. 7, Stone figure of a lizard (?) from Mullaley, New South Wales. 8, Double-ended conical stone from the Adelaide River, Northern Territory. 9, Cylindro-conical stone from Point Plomer, New South Wales. 10, Distal end of a cylindro-conical stone from Attunga, New South Wales.

even shallower groove. The two opposite grooves are separated by a median ridge on one lateral margin, and the opposite but much wider lateral margin has a similar arrangement. A fourth specimen, similar to the last-mentioned one but smaller, being 6 × 1·5 × 1·3 cm., has four shallow grooves asymmetrically distributed around the middle.

There are four imperfect well-used specimens, E.53330.1–4, each one broken across the middle of the groove, and one across one end also, which are from 5 to 5·6 cm. long. The fracture faces are not patinated.

E.53229.5–12 and 53488.1 comprise eight complete and one broken specimens on which the use is not so pronounced. One, 8 × 2 × 1·7 cm., has two opposite slightly concave and polished surfaces, and a narrow bevel 2 mm. wide extending partly along one edge of each surface. Six others, from 7 to 11 cm. long, possess from one to five grooves, most of them as part of an encircling series. One of these, with five grooves, 3 × 3·5 cm. in width and thickness, is the stoutest example in the whole series. One is a curved piece of material.

On all of the above specimens the two ends are comparatively flat and patinated, and they bear no signs of any kind of use.

The two remaining specimens are similar to each other, are broken across the groove, and the fracture or cleavage surface, and the facets of the grooves, have since become patinated. E.53488.2 (Figure 4), is 5·5 × 2·5 × 2 cm., oval in transverse-section, and its surface has a dull water-rolled appearance. It has in all five faces tapering towards one end which bears one side of an encircling groove, made up of four facets, broken through the middle. E.53330.5 (Figure 5) is highly polished all over, 7 × 2·5 × 1·8 cm., and rectangular in transverse section. At one end of one of the broader surfaces is a wide bevelled groove, which slopes upwards at each end, and adjoins two narrow grooves which end abruptly against the patinated end. E.53488.2 is patinated all over, including the surface of the grooves, but on E.53330.5 the patination is worn through to the black surface underneath on the large groove, and the two narrow grooves adjoining it are both patinated and polished.

The *Morella*-type was apparently used as a polishing implement for shaping and finishing-off rounded wooden surfaces such as the shafts of clubs and other objects. Each of the well-worn specimens was no doubt used over a very long period of time for a groove to be worn to a depth of 4 mm. into the stone by the polishing of fine-textured surfaces. They were probably carried about by their owners. One, for example, 53299.1, has no less than eight grooves on its completely polished surfaces. In use the implement was apparently held at one end and turned over when a narrower or shallower groove was required.

Four complete and four broken specimens possess one thick and one thin lateral margin, the latter being a thin median ridge on some examples. Thus their wedge or triangular section would be ideal for the fitting to them of a withe hafting of the kind used on edge-ground axes. The withe would be bent around the thick lateral margin or back, fitted along the upper and lower surfaces, and tied tightly together at the thin margin. In view of the fact that the ends show no signs of use, the only reason for hafting them would be for some unknown and non-practical function. The groove is obviously a result of the way in which they were used for polishing purposes, and is a functional character.

Giligulgul-type.—The first examples of this hitherto unrecorded type were forwarded by Mr. J. M. Clift in 1946, and others subsequently. One was found on top of a dam excavation and had apparently been buried, but the others are surface specimens, from his property, Giligulgul, on the Darling Downs. His brother found one at Nangram Lagoon, and Mr. A. G. Davidson found one on his property, Guluguba, next to Giligulgul. The author found one at Lake Conjola, on the south coast of New South Wales. They are made from water-worn pebbles comprising a variety of highly siliceous and fine-grained sedimentary rocks among which are chert, jasperoid, and shale, with the possible exception of one igneous rock.

They form an heterogeneous series as follows: Two side-blow flakes 4·5 and 5 cm. long, with longitudinal polished faces, one of which is figured (Figure 12); thicker portion of a split-pebble 4 cm. long, roughly flaked round one end, with a longitudinal polished face (Figure 3); three pebbles (Figure 4), 5, 5, and 10 cm. long, with transverse polished faces from 2·3 to 3 cm. wide, the largest one (Figure 17) of which is a perfect example from Guluguba, and one 6 cm. long from Lake Conjola whose face is unpolished; a long igneous (?) pebble (Figure 16), 11·6 × 6·2 × 4 cm. with one transverse polished face on the cleavage surface and another smaller one 5·4 × 4 cm. long on the outer surface; a triangular sector (Figure 15) 3·4 cm. long, with two polished faces meeting in a sharp edge (unused), the smallest specimen in the series, made of a banded stone; an irregular piece of chert, 5·7 cm. long, with two small polished faces meeting at one end; an elongate pebble (Figure 11), 9 cm. long from Nangram Lagoon, Queensland, with a flat face which is patinated but which bears no signs of polishing.

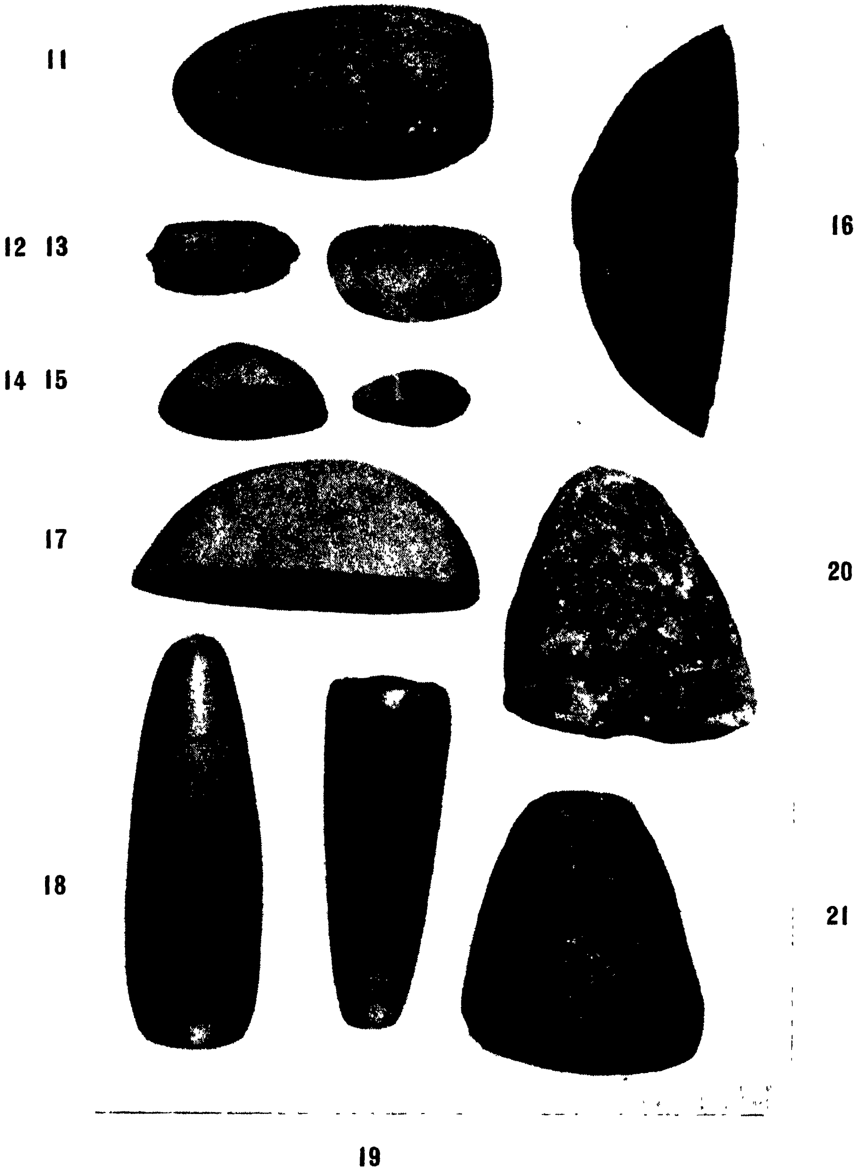
In fashioning these implements the split-pebble technique was employed, probably block-en-block in which the pebble was stood on an anvil-stone. In all specimens the cleavage surface is flat and sharp-edged, features which are accentuated by the fine-grained materials used and by their rubbing or polishing use. On several the percussion fissures are apparent and the polishing occurs only on the ridges, but on the others no impact spot, bulb, or fissures are present. The polished surface is longitudinal on four, transverse on five, and on two sides of one irregular piece longitudinal and transverse, meaning with or across the layering or grain of the stone respectively. This surface does not bear any striations from grinding so that it has been produced by contact with a fine-textured surface, as with the *Morella*-type, and on all specimens it is so flat and well-defined that at first sight it does not seem possible that the natives could have produced it. On most of the specimens, too, the polished surface is lightly patinated. Mullers often bear a very smooth or polished grinding surface, but it is much larger in area than on the *Giligulgul*-type, the function of which might have been the finishing-off of wooden weapons and other objects.

A STONE FIGURE FROM NEW SOUTH WALES.

(Figure 7.)

Mr. V. Ellis, of Mullaley, recently presented to the Museum a unique stone figure, the only one yet recorded in Australia. This figure represents a lizard, so far as one can judge, but of what type it is impossible to say, although a goanna is the most probable one. The aborigines used natural stones to represent various animal totems and their eggs, but to my knowledge there is no other record of a stone sculpture on the continent. This example was ploughed up in virgin land on a spur in the Kooringal portion of the Pilliga scrub, on the edge of the black soil plains, 15 miles from Mullaley which is situated in a triangle between Gunnedah, Boggabri and Coonabarabran on the northern tableland.

The figure is made of an igneous rock, probably basalt, weathered to a light grey on the surface. The stone occurs locally. It is 39·9 cm. long, and just more than 5 cm thick and wide. Two sides are flat and one convex, so that it is triangular in transverse section, although the tail is plano-convex. The head is defined by a deep encircling groove, 1 cm. wide and 3 mm. deep, but is not shaped in any other way, nor are the features indicated. The body increases in thickness from the neck, on the convex surface, and the thickest portion of the body is one-third of the length from the head. It then slopes downward to the tail, which terminates in a narrow convex and sharp edge. There are two narrow grooves on the body; one is a complete one which projects backwards in a semi-circular loop towards the tail on the convex and on one of the flat surfaces, and forwards towards the head on the other flat surface, where there is a shallow groove up to 2 cm. wide in front of it, and then a narrow oblique groove which is evidently intended to be like the other encircling one but was not completed. Along the complete body groove the lower side has been ground away to form a step or slight difference in



Figures 11–21.

11–16, Abrading implements of Gilligulgul-type found by Mr. J. M. Clift. 17, Abrading implement of Gilligulgul-type found by Mr. A. G. Davidson. 18–19, Cylindro-conical sago-strippers from Aitape and Vanimo, northern New Guinea. 20, End of a cylindro-conical stone from Bulga, Hunter River Valley, New South Wales. 21, End of a cylindro-conical stone from Baradine, New South Wales.

the levels of the surface on each side, thus separating the body portion from the tail. There are no other markings, and the only other shaping of the specimen would appear to have been that of the tail. It was evidently a conveniently shaped piece of stone requiring very little work to produce this figure.

Cylindro-conical Stones and Sago-strippers.

The Australian Museum has acquired in recent years four cylindro-conical stones from north-eastern New South Wales and one from the Northern Territory which add considerably to the known distribution of these implements.

E.52565 (Figure 8) is a unique type presented by Captain W. Murphy, which he found on black soil plains, two miles from the Adelaide River and four miles east of Humpty Doo Station, in the Northern Territory. The only comment given by local natives to Captain Murphy was that it was made a long time ago, but Mr. W. E. Harney was told by one of the old men from the area that he had seen such stones in use—they were buried until required for certain ceremonies during which they were rubbed on a girl reaching puberty to ensure her fertility.

It is made of a coarse light-grey and light-buff coloured quartzite, comparatively soft in texture. Around the periphery of each of four cleavage faces, the specimen being in three pieces, is a ring of brown patination from 3 to 4 mm. thick. It is a bi-conical implement, 31·5 cm. long and 8 cm. in diameter in the middle, weighing 7 lbs. 3 oz. It is neatly shaped by pecking but bears no incised markings. It is asymmetrical, one half being slightly more convex than the other. On one end a thin spall has been knocked off, and the other end is rounded and unmarked. This is the only bi-conical implement of this type recorded in Australia.

E.53649 (Figure 9) is a straight cylindrical stone from Point Plomer, on the far north coast of New South Wales, in the C. C. Towle collection of stone implements in this Museum. It is made of a grey knotted schist, and the smooth surface is roughened by weathering on one side. The butt is an oblique flat surface. A large flake is missing from one side of the conical head (as shown in Figure 9), and two series of flakes have been struck off the edge of the butt. It bears no incised markings, and is 26 cm. long, 6 × 5·5 cm. in width and thickness across the butt. This is the only cylindro-conical stone known from the coast of New South Wales and it was found on a surface shell-midden.

The other three specimens are distal ends only. E.52402 (Figure 10) was presented by Mr. E. D. Coulter who found it on the top of a limestone ridge, 6 miles north-east of Attunga and 1¼ miles due east of the 20-mile peg on the Tamworth-Manilla road, on "The Braes", a station owned by Mr. Atkinson. With it were found edge-ground axes and a percussion stone. It is made of a local hardened gritstone, and was shaped by pecking. There are slight percussive abrasions on the rounded end. The cleavage face bears a brown iron-stained patination. It is oval in transverse-section, measuring 6·5 × 5·6 cm., and the piece is 12·5 cm. long. E.50752 (Figure 20) was presented by Mr. A. N. Eather who found it in open pastoral and farming country at Bulga, on the southern side of the Hunter River Valley. It is made of coarse sandstone and its surface is stained and discoloured by exposure. It is rectangular, with rounded corners, in transverse section measuring 7 × 5 cm. in width and thickness, and is only 8 cm. long. On the surface it bears about two dozen roughly parallel longitudinal rows of short straight incisions about 8 mm. long. The point is battered and several fragments were knocked off during this usage. E.53698 (Figure 21) was presented by Mr. G. H. McNaught who found it in plains country at Baradine, on the northern tableland of New South Wales. It is made of sandstone, is 8 cm. long, the pointed end has been battered to a flat a flat face 2 cm. in diameter and the other end is a battered convex surface 7 × 5 cm. in size. Its most recent functions, therefore, have been those of a hammerstone and pestle. It is possible that the Bulga and Baradine specimens reached these localities by trade from western New South Wales.

Three New Guinea implements, two of which are illustrated (Figures 18–19), in our collection are of interest in connection with the occurrence of the cylindro-conical stone in Australia, but whether the similarity in form of the implements in these two regions has any significance is not known. These specimens are three sago-strippers used to break up the pith in sago logs. They are made of a mottled serpentine, and are all very well shaped, highly polished cylindro-conical implements, each possessing a well-cupped base and a battered distal end. The outer edge of the base on each one is striated and is worn inwards from use. E.28679 from Uweal, Aitape district, is 10·5 long and 3·5 cm. in diameter, and E.29897 from Murik, Aitape district, is 12 cm. long and 3·5 cm. in diameter, both being presented by Mr. R. F. Armstrong; E.33010 from Vanimo is 10·5 cm. long and 3·5 cm. in diameter, and was presented by Mr. G. A. V. Stanley with a note stating that it had come from Netherlands New Guinea by trade. A similar implement, lacking the cupped base, is recorded on far-away Rossel Island by Armstrong (1928, p. 30, pl. XIIB), but hafted wooden sago-strippers of the same shape are used by many of the sago-working peoples of New Guinea. Collings (1949, pp. 18 and 21, Figures 2–3) has described several examples collected on the Kelabit Plateau by T, Harrisson, Curator of the Sarawak Museum, from Ulu Lawas in the Murut country, in Borneo, and one from Netherlands' New Guinea.

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THE AUSTRALIAN FRESHWATER CRABS (POTAMONIDAE).

By E. F. Riek.
Commonwealth Scientific and Industrial Research Organization — Division of Entomology, Canberra, A.C.T.

(Figures 1–7.)

Freshwater crabs of this family are common in the inland and northern portions of Australia, but are unknown from the south-east and south-west coastal areas. Most of the recorded species were described from specimens collected in Cape York. Only one species, *Paratelphusa leichardti* (Miers), is widespread in inland areas. It causes some damage to bore-drains as the burrows of the specimens increase seepage from the drains and so cut down the flow.

Family POTAMONIDAE.

The family is generally subdivided on the structure of the mandibular palp, though some authors recognize more than two subfamilies.

1. Terminal segment of the mandibular palp deeply cleft into two lobes, one dorsal and one ventral .... subfamily GECARCINUCINAE
Terminal segment of the mandibular palp not deeply cleft into two lobes .... subfamily POTAMONINAE

Subfamily POTAMONINAE.

There is no authentic record of a species of this subfamily from the Australian mainland although the generic name *Geotelphusa* was applied to some Australian species by one early author.

Subfamily GECARCINUCINAE.

Mandibular palp divided into two lobes, a dorsal and a ventral. The dorsal lobe is falciform and lies behind the incisor process of the mandible; the ventral lobe, which is a broad oval plate, more or less covers the exposed surface of the incisor process. Very commonly the abdomen of the adult male is broad at the base and suddenly narrowed at the fifth and sixth segments, but whether this is so or not, the length of the sixth segment is hardly ever less than (often exceeds) its minimum breadth, and the seventh segment (telson) is elongate triangular or tongue-shaped, not broadly triangular.

Key to Genera and Subgenera of the Subfamily GECARCINUCINAE.

1 Front in adult less than one and one-half times as wide as orbit 2
Front in adult usually much wider than, never less than one and two-thirds as wide as orbit 3

2. Lower, outer corner of orbit produced into a sort of gutter .... *Gecarcinucus* (India)
Orbits normal .... *Cylindrotelphusa* (India and New Guinea)

3. Upper border of merus of chelipeds with a subterminal spine 4
— Upper border without subterminal spine 5

4. Post-orbital crests prominent .... Subgenus *Paratelphusa** (Asia, Africa, Malaya)
— Post-orbital crests faint or obsolete .... *Peritelphusa* (Malaya)

5. Post-orbital crests prominent 6
– Post-orbital crests low, indistinct 8

6. Epigastric and post-orbital portions of crest either continuous or almost in line .... *Barytelphusa** (Asia, Malaya)
- Epigastric portion in advance of and slightly overlapping post-orbital portion of crest 7

7. Exopodite of external maxillipeds strongly flagellate .... *Oziotelphusa** (Asia)
Flagellum of exopodite of external maxillipeds vestigial or absent .... *Phricotelphusa** (Asia)

8. Exopodite of external maxillipeds flagellate .... *Liotelphusa** (Asia, Malaya, Australia)
- Exopodite of external maxillipeds non-flagellate .... *Globitelphusa** (Asia)

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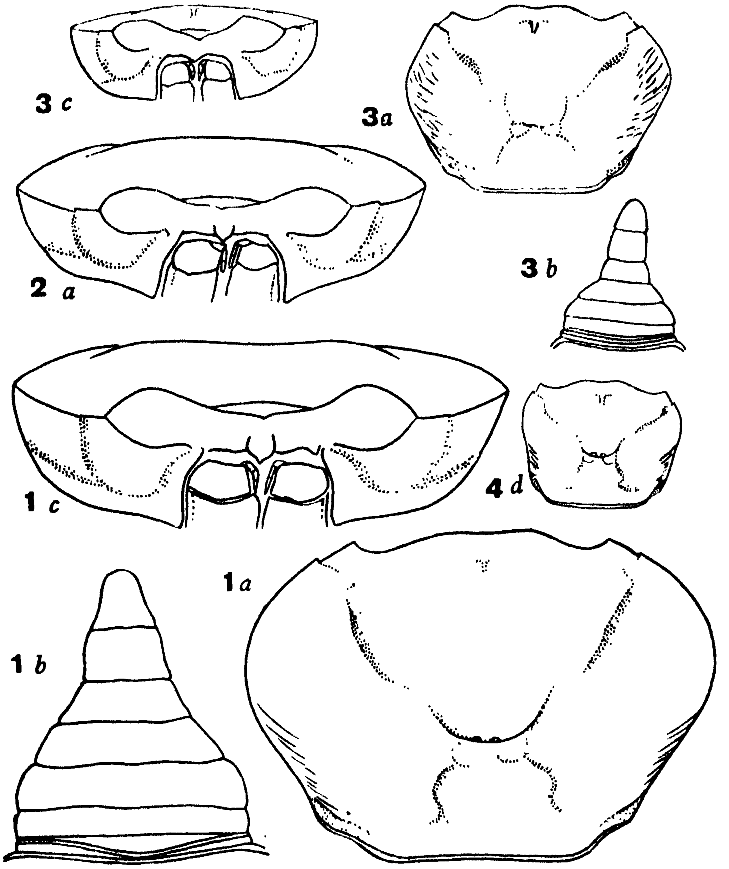
* Subgenera of *Paratelphusa*.



Figures 1-4.

1. *Paratelphusa* (*Liotelphusa*) *leichardti*, Lawn Hill Creek, Northern Territory. 2 *Paratelphusa* (*Liotelphusa*) *leichardti*, Longreach, Queensland. 3. *Paratelphusa* (*Liotelphusa*) *plana*. 4. *Paratelphusa* (*Liotelphusa*) *planifrons*. (*a*) Male cephalothorax. (*b*) Male abdomen. (*c*) Frontal view. (*d*) Juvenile cephalothorax. Approximately × 1½ diameters.

Genus **Paratelphusa** Milne Edwards 1853.

In this genus it is unusual for the abdomen of the adult male to be regularly triangular; it is far more usual for its distal half to be narrowed, the narrowing beginning suddenly at the fifth or sixth segment. Whether this contraction is marked or not, the sixth segment is never broad, its length almost always being equal to and not unseldom exceeding its distal breadth; and the telson is never broadly triangular but is broadly semi-elliptical or tongue-shaped, or at least, elongate. The mandibular palp is of a peculiar pattern, the first two joints are not separately distinguishable, they certainly have no movement independent of one another, and the terminal joint is divided, from the base, into two lobes, one dorsal and the other ventral.

Subgenus **Liotelphusa**.

This subgenus is not sharply defined and it grades into *Phricotelphusa*, although the extremes are very distinct.

Antero-lateral borders of the carapace not spinose; epigastric and post-orbital crests obscure; lateral epibranchial spine small or minute; the exopodite of the external maxillipeds usually with a long, strong, plumose flagellum; the cervical groove distinctly cut only where it defines the mesogastric area posteriorly; species usually small. There are five Australian species of the subgenus.

Paratelphusa (Liotelphusa) leichardti (Miers), 1884.

(Figures 1–2.)

Telphusa leichardti Miers, 1884, Zool. Alert., 236.

Telphusa transversa Spencer, 1896, Horn Exped., II. Zool., 245.

Geotelphusa leichardti McCulloch, 1917, Rec. Aust. Mus., xi, 232.

Paratelphusa transversa Hale, 1927, Flora Fauna S. Austr., Crustacea, i, 154.

Diagnosis.—Lateral margins of the front divergent backwards; fronto-orbital breadth less than the length of the cephalothorax; penultimate leg much less than twice as long as the cephalothorax; post-frontal elevations obsolete or absent, branchial regions almost or quite smooth anteriorly.

Description.—A full description of this species is given by McCulloch (1917).

Type Locality.—South-west Queensland.

Distribution.—Inland and northern Australia including localities in South Australia, New South Wales, western Queensland (as far north and east as Hughenden and Charters Towers), Northern Territory (Darwin and Lawn Hill Creek) and Western Australia (King Sound).

This species can be separated into two well-defined forms: the typical form occurring in the southern part of the range, the inland streams of western Queensland and reaching towards the coast at Charters Towers; and the northern form occurring at Lawn Hill Creek and Darwin, Northern Territory, and at King Sound, Western Australia. Both the forms are figured. This common, wide-ranged species is not known from Cape York. The species is most closely allied to *transversa* (von Martens), which replaces it in Cape York.

Paratelphusa (Liotelphusa) plana (McCulloch), 1917.

(Figure 3.)

Geotelphusa leichardti var. *plana* McCulloch, 1917, Rec. Aust. Mus., xi, 236.

Description of Adult.—Carapace broadly oval, deep, length about three-quarters of the greatest breadth, depth less than half the length; upper surface relatively smooth, except for fine, oblique striae on the dorsal surface near the lateral borders of the epibranchial region. The striae are much more noticeable in juvenile specimens. Cervical groove rather strongly impressed for this subgenus, more prominent in the posterior mesogastric area and there quite deep, running towards the lateral epibranchial tooth, quite deeply impressed for the middle third of this portion; regions of the carapace thus fairly well defined; anterior border of the mesogastric area, however, not well defined except at the groove separating the epigastric crests; epibranchial region little, if at all, swollen; front about one-quarter of the greatest breadth of the carapace, slightly deflexed, smooth-edged and with the free edge almost straight; outer orbital angle sub-acute, not separated from the lower border of the orbit by a gap; antero-lateral border of the carapace well defined, strongly convexed; epigastric and post-orbital crests ill-defined, epigastric crest regions separated medianly by a very faint groove; abdomen of male tapering rather abruptly to the fifth and sixth segments; sixth segment with straight sides, almost as long as wide at its distal end; telson not quite as long as its proximal width, apex rounded; external maxillipeds with the exopodite longer than the ischium and bearing a strong, plumose flagellum; ischium longitudinally grooved, merus quadrangular and broader than long. Length of holotype, 23 mm., breadth, 30·5 mm.

Types.—Holotype male, allotype female and paratype (No. P.4110–P.4112) in the Australian Museum Collection.

Type Locality.—Eureka Creek, Walsh River, Cape York.

Distribution.—Walsh River and Cooktown, north Queensland.

In the holotype the oblique striae on the dorsal surface near the lateral borders of the epibranchial region are faint but still distinguishable. They are more prominent in the specimens examined from Cooktown. The species is distinguishable from *leichardti* on the form of the carapace and in the development of the oblique striae on the dorsal surface near the lateral borders of the epibranchial regions in *plana* which are absent in *leichardti*. The male abdomen also is different in the two species.

Paratelphusa (Liotelphusa) planifrons (Bürger), 1894.

(Figure 4.)

Telphusa planifrons Bürger, 1894, Zool. Jahrb. Syst., viii, 6.

Diagnosis.—Lateral margins of front parallel; fronto-orbital breadth equal to the length of the cephalothorax; breadth only slightly greater than the length.

Length of cephalothorax, 17 mm., breadth, 23 mm.

Distribution.—Cape York; Walsh River, north Queensland (10 May, 1925, W. D. Campbell); Mutchilba, Chillagoe Line, north Queensland (W. D. Campbell).

Only three very juvenile specimens (width, 15 mm.) referred to this species have been examined. However, the species can be distinguished readily from *plana* and the other species on its shape. In *planifrons* the lateral margins tend to be parallel so that the carapace has a squarish appearance, the width being only slightly greater than the length.

Paratelphusa (Liotelphusa) transversa (von Martens), 1869.

(Figure 5.)

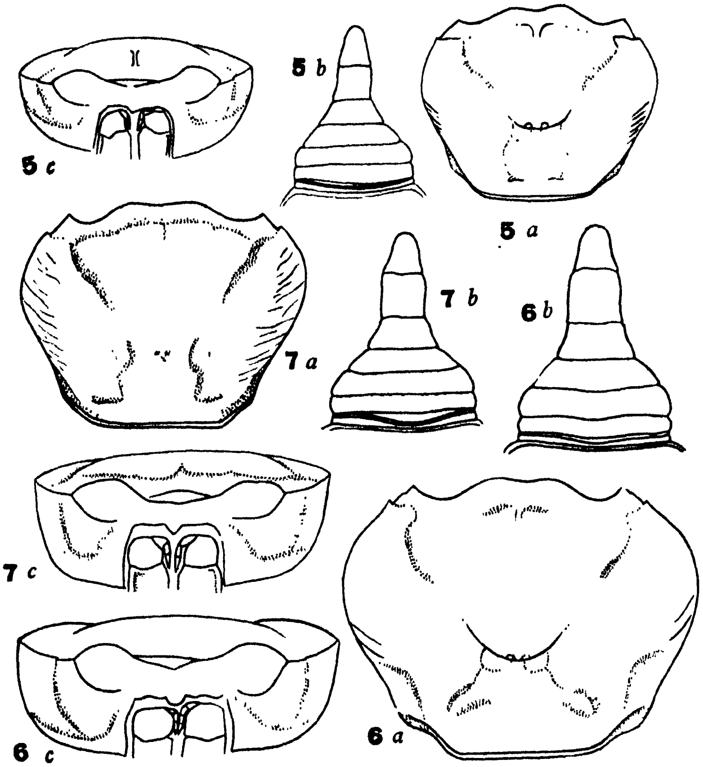
Telphusa transversa von Martens, 1869, Monats. Ak. wiss. Berlin, 609; Bürger, 1894, Zool. Jahrb. Syst., viii, 4.

Telphusa crassa Milne Edwards, 1869, Nouv. Arch. Mus. Paris, v, 177.

Diagnosis.—Carapace strongly convex from in front behind; upper surface smooth; epibranchial spine very reduced so that the antero-lateral borders appear almost entire; post-frontal crests absent.

A single male specimen from Mapoon, Batavia River (Australian Museum Collection, No. G.4219) is referred to this species. The proportions of the carapace do not correspond exactly with those given for the type specimen, but then this specimen is smaller.

Description of Specimen G.4219.—Carapace oval, almost circular in outline, deep, its length about three-fourths of its greatest breadth, depth greater than half its length; upper surface relatively smooth, without striae on the dorso-lateral portions of the epibranchial region; cervical groove deeply impressed only in the posterior mesogastric area, running towards the lateral epibranchial tooth, prominent only over the middle third of this portion; anterior border of the mesogastric area not well-defined except at the groove separating the epigastric crests; front about one-quarter the greatest breadth of the carapace, strongly deflexed, smooth-edged, with the free edge strongly emarginate in the middle; antero-lateral borders of the carapace well-defined, tending towards being parallel; epigastric and post-orbital crests, though ill-defined, forming a continuous line; abdomen of male tapering rather abruptly to the fifth and sixth segments; sixth segment with almost straight sides, as long as wide at its distal end; telson as long as its proximal width, apex rounded.



Figures 5–7.

5. *Paratelphusa* (*Liotelphusa*) *transversa*. 6. *Paratelphusa* (*Liotelphusa*) *valentula*, sp. nov. 7. *Paratelphusa* (*Barytelphusa*) *angustifrons*.
(*a*) Male cephalothorax. (*b*) Male abdomen. (*c*) Frontal view. Approximately × 1½ diameters.

Breadth of carapace, 26 mm., length, 21 mm.

Type Locality.—Cape York, north Queensland.

Distribution.—Cape York; Mapoon, Batavia River, Cape York (August, 1903, C. Hedley).

The species is much deeper than *plana* and the upper surface much more strongly arched. The much more strongly arched surface and strongly deflexed front, as well as slight differences in the shape of the male abdomen differentiate this species from *leichardti*.

Paratelphusa (Liotelphusa) valentula, sp. nov.

(Figure 6.)

Description of Adult.—Carapace squarish, length more than three-quarters of the greatest breadth, depth less than half the length; dorsal surface smooth or with very fine striae on the epibranchial regions; cervical groove deeply impressed only where it borders the posterior mesogastric area, running towards the lateral epibranchial tooth, clearly defined only in the middle third of this portion; epibranchial regions greatly swollen; front about one-quarter the greatest breadth of the carapace, slightly deflexed, smooth-edged, with the free edge slightly excavated; outer orbital angle sub-acute, not separated from the lower border of the orbit by a gap; epigastric and post-orbital crests ill-defined; epibranchial spine prominent; abdomen of male tapering rather abruptly to the fifth and sixth segments; sixth segment with almost straight sides, slightly longer than the width at the distal end; fifth segment approaching in length its minimum breadth so that the abdomen is markedly constricted at the fifth segment; telson slightly longer than its proximal width, apex rounded.

Length of holotype male, 27 mm., breadth, 34 mm.

Types.—Holotype male (No. P.11982), allotype female (No. P.11983), and paratypes in the Australian Museum Collection.

Type Locality.—Coen, north Queensland.

Distribution.—Coen (Jan., 1943, Wassell); Coen River at Coen (June, 1949, R. Mackay).

This species is quite distinct from any of the other Cape York species. It is characterized by the swollen epibranchial regions. The male abdomen also is most distinctive.

Genus **Paratelphusa.**

Subgenus **Barytelphusa** Alcock.

No spine on the upper border of the merus of the chellipeds, antero-lateral border of the carapace crenulate or not, but never bearing a series of large teeth or spines; epigastric crests either united with the post-orbital crests to form one unbroken ridge on either side of the post-frontal mesogastric groove, or, if the epigastric crests are separated from the post-orbital crests, the break between them is vague and sometimes very indistinct and both crests form one common curve; exopodite of the external maxillipeds with a long, strong, plumose flagellum; cervical groove usually very broadly and deeply impressed in all its course, usually running to, or towards, the lateral epibranchial spine. The species are generally large and dark-brown in colour.

Paratelphusa (Barytelphusa) angustifrons (Milne Edwards), 1868.

(Figure 7.)

Telphusa angustifrons Milne Edwards, 1868, Bull. Soc. ent. Fr.; Milne Edwards 1869, Nouv. Arch. Mus. Paris, v, 171.

Geotelphusa angustifrons McCulloch, 1917, Rec. Aust. Mus., xi, 232.

Paratelphusa (*Liotelphusa*) *podenzanae* Colosi, 1919, Boll. Soc. Ent. Ital., l, 54.

Diagnosis.—Lateral margins of the front divergent backwards, fronto-orbital breadth less than the length of the carapace; pronounced post-frontal elevations extending between the epibranchial teeth; branchial regions markedly rugose, both anteriorly and posteriorly.

Description of Adult.—Carapace slightly arched, the three main divisions distinct, length about four-fifths the greatest breadth, the depth more than half the length; lateral half of each epibranchial region traversed by a number of fine oblique ridges becoming somewhat effaced in very large specimens; cervical groove distinct except for the region behind the post-orbital crests, the groove running to the lateral epibranchial tooth; mesogastric furrow deep; front one-quarter the greatest breadth of the carapace, little deflexed, margin entire, with sides convergent forward; external orbital tooth subacute, meeting the lower border of the orbit without a notch; antero-lateral margin of the carapace well-defined, very obscurely crenulate; epibranchial tooth small and blunt; epigastric crests broad, blunt, almost parallel to the front, outer ends incompletely separated from the post-orbital crests by a very vague break; post-orbital crests rounded, most clearly defined over their outer halves, running slightly backwards and then with a distinct forward bend from the region of the cervical suture to join the lateral margin at the epibranchial tooth; male abdomen broad based, distally strongly contracted with broadly rounded apex, contraction of the sixth segment pronounced, segment just as long as broad at its distal end; telson broadly rounded, as long as broad promixally.

Length of normal carapace, 23 mm., breadth, 28 mm.

Distribution.—Cape York (type locality); Paira, near Somerset, Cape York (Hedley and McCulloch).

The type locality of *podenzanae* Colosi is also Cape York.

The species can be distinguished from all other recorded Australian species by the relatively strong development of the epigastric and post-orbital crests. The species differs from typical members of the subgenus in the relatively poor development of the cervical groove, the lateral portions of which are broken in the middle. The condition found in this species is very similar to that which occurs in the subgenus *Oziotelphusa* but the epigastric and post-orbital crests, though not as prominent as in most species of the subgenus *Barytelphusa*, are definitely in line. Colosi, after stating that this species would fall in the subgenus *Barytelphusa*, as defined by Alcock, placed it in *Liotelphusa* without any further explanation.

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THE AUSTRALIAN FRESHWATER PRAWNS OF THE FAMILY PALAEMONIDAE

By E. F. Riek.

Commonwealth Scientific and Industrial Research Organization — Division of Entomology, Canberra, A.C.T.

(Figures 1–11.)

The freshwater species of this family are found in the permanent waters of creeks and rivers and to a less extent of dams and waterholes. In the small standing water one is more likely to find prawns of the family Atyidae. The species appear to have a peculiar distribution in Australia. The dominant genus *Macrobrachium* occurs throughout northern Australia and inland Australia south into South Australia where there is at least one coastal species. It is apparently absent from south-west Western Australia but a species of *Palaemonetes* is recorded from there. Species are not known over most of Victoria, and on the east coast of Australia records are confined to Queensland. Intensive collecting around Sydney has failed to yield any freshwater species.

Family PALAEMONIDAE.

Caridea in which the first two pairs of legs are chelate, but dissimilar. The wrist of the second pair of legs is not divided and the rostrum is not hinged, but rigid.

Subfamily PALAEMONINAE.

A pleurobranch is present at the base of the third maxilliped; posterior margin of the telson with two pairs of spines and two or more plumose setae.

Only two genera of this subfamily are represented in the Australian freshwater fauna. The genus *Palaemonetes* is recorded with a single species from the south-west region of Western Australia. The genus *Macrobrachium* is widespread over the eastern half of the continent but is unknown in the coastal zone south from the Queensland border and over most of Victoria.

Genus **Macrobrachium** Bate, 1868.

Genotype, *Macrobrachium americanum* Bate, 1868.

Antennal and hepatic spines present; supraorbital and branchiostegal spines absent; mandible distinctly cleft, normally with a large three-segmented palp; dactylus of last three pairs of legs simple.

The species normally occur in freshwater but some may also be found in brackish and even salt water. Some Australian species seem to be entirely marine or really estuarine, for example, *novae-hollandiae* and *danae*, as an extensive search has failed to disclose any specimens in fresh water.

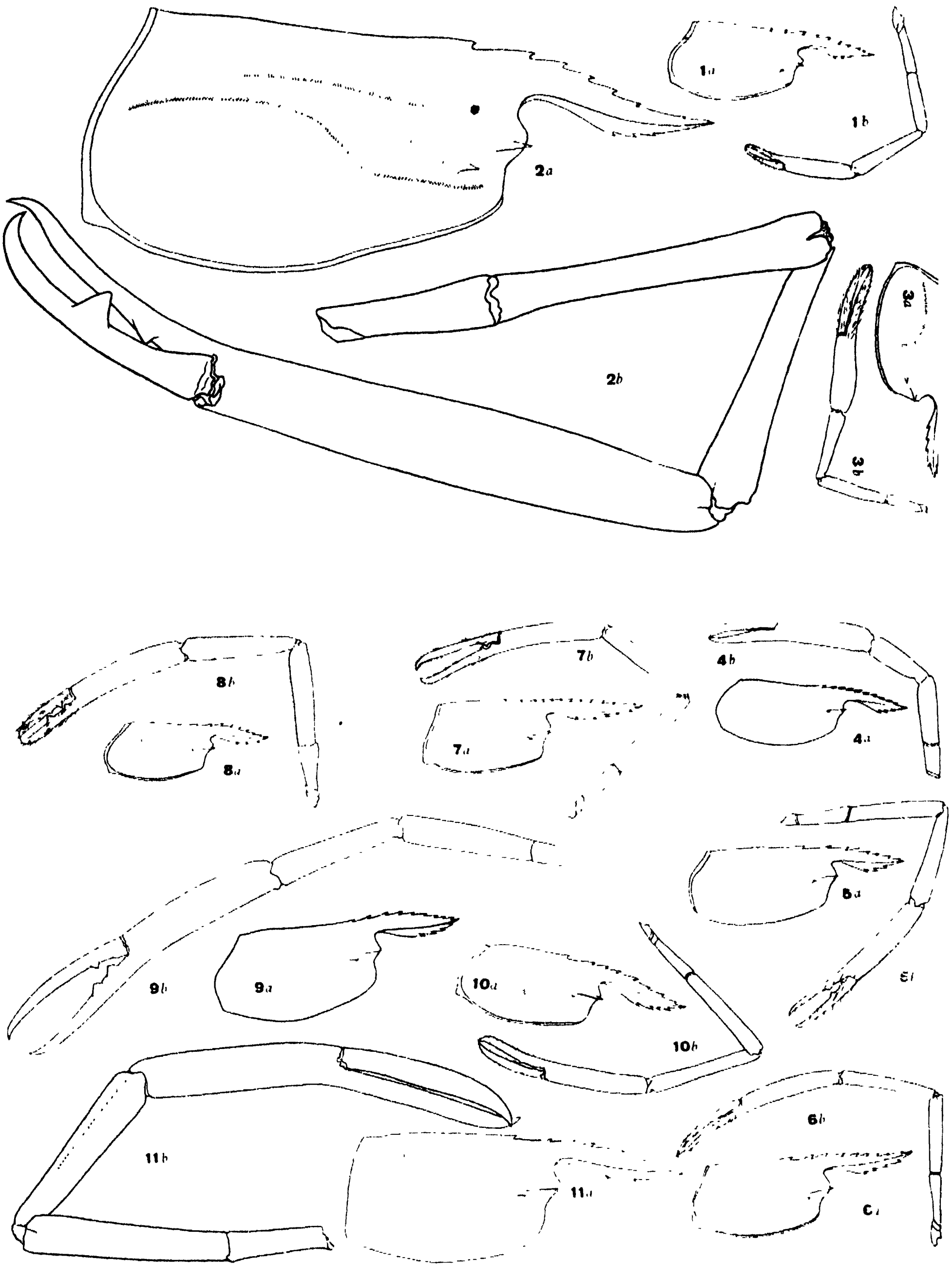
This genus has generally been considered as *Palaemon* while most species of *Leander* are now placed in *Palaemon*. *Leander* and *Palaemon* are typically marine though some species of *Palaemon* do occur in fresh water.

Macrobrachium novae-hollandiae (de Man), 1908.

Palaemon (*Eupalaemon*) *novae-hollandiae* de Man, 1908, Ann. Mag. Nat. Hist., (8), 1, 370.

Palaemon ornatus Haswell, 1882, Catalogue Austr. Crustacea, 196.

Macrobrachium novae-hollandiae Holthuis, 1950, Siboga Exped. 39, Decapoda 10, 155.



Figures 1-11.

1. *Macrobrachium tolmerum*, sp. nov. 2. *M. lar* (Fabricius). 3. *M. adscitum adscitum*, sp. nov. 4. *M. glypticum*, sp. nov. 5. *M. atactum atactum*, sp. nov. 6. *M. atactum ischnmorphum*, sp. nov. 7. *M. atactum sobrinum*, sp. nov. 8. *M. australiense eupharum*, sp. nov. 9. *M. australiense cristatum*, sp. nov. 10. *M. australiense australiense*, Holthuis. 11. *M. australiense crassum*, sp. nov.

(*a*) Cephalothorax. (*b*) Second periopod of male. Setae of fingers omitted from Figures 4, 9 and 11. Natural size.

This species, though common in the estuaries from Sydney to Brisbane, has never been collected in fresh water; in fact, no prawns of the subfamily Palaemoninae are known from the fresh waters of the Sydney district. There is some variation in the proportions of the chelae which, however, are always extremely long and on this character alone easily distinguishable from *danae* which has a similar distribution.

Macrobrachium danae (Heller), 1865.

Palaemon Danae Heller, 1865, Reise Novara Zool. 2, 120.
Palaemon danae de Man, 1908, Ann. Mag. Nat. Hist. 8, 1, 363.
Macrobrachium australe Holthuis, 1950 (in part), Siboga Exped. 39, Decapoda 10, 124.

Holthuis considers *danae* (Heller) a synonym of the freshwater species *australe* (Guérin Méneville). The species *danae* is restricted almost entirely to salt water though it may enter small freshwater springs and swamps at the shore-line. Ovigerous females are normally collected in salt water. Adult males have the second periopods equal and have a shorter carpus than in *australe*. The teeth on the cutting edges of the fingers also differ. There are a number of small teeth proximally but the distal tooth is the largest in *danae*.

Key to the Australian Freshwater Species of *Macrobrachium*.

1. Merus distinctly shorter than carpus 2
— Merus almost or quite equal to carpus 5
— Merus slightly greater than carpus 3

2. Large species; telson with apex long, acuminate, lateral spines not reaching the apex of the telson ... *rosenbergi* (de Man)
— Small species; telson with apex short, acuminate, the inner of the lateral spines extending well beyond the apex of the telson .... *tolmerum*, sp. nov.

3. Telson with apex rounded, lateral spines short; large species. (Second periopods strongly tuberculate, palm not swollen) .... *lar* (Fabricius)
- Telson with apex short, acuminate, inner of lateral spines extending beyond apex of telson; small species 4

4. Second periopods smooth; rostrum above only slightly convex, fingers appearing smooth; fingers as long as palm
    Palm greatly swollen .... *adscitum adscitum*, sp. nov.
    Palm not swollen .... *adscitum* subsp.
- Second periopods tuberculate, all segments inflated; rostrum short, convex above, fingers appearing smooth, fingers shorter than palm, carpus only three times as long as wide and much shorter than palm ... *glypticum*, sp. nov.

5. Fingers of second periopods appearing bare or with only short hairs; second periopods long and thin, not obviously tuberculate 6
— Fingers of second periopods clothed with long, dense hairs; second periopods rather stout, obviously, though finely tuberculate 7

6. Rostrum with the upper margin slightly convex, apex not upturned; carpus as long as palm; fingers not quite as long as palm; carpus five to six times as long as wide .... *atactum atactum*, sp. nov.
- Rostrum long, with the upper margin almost straight, apex slightly upturned; carpus generally longer than palm; fingers longer than palm; palm slightly swollen; carpus seven times as long as wide .... *atactum ischnomorphum*, nov.
— Rostrum long, upper margin slightly convex, apex slightly upturned; carpus almost as long as palm; fingers almost as long as palm; carpus about six times as long as wide .... *atactum sobrinum*, nov

7. Rostrum above strongly convex; carpus shorter than palm; carpus four to four and one-half times as long as wide ... *australiense eupharum*, nov.
— Rostrum above convex, apex not upturned; carpus shorter than palm; carpus four to four and one-half times as long as wide; periopods very stout, palm slightly swollen .... *australiense cristatum*, nov.
— Rostrum above only slightly convex, apex slightly upturned; carpus as long as palm; carpus five to six times as long as wide .... *australiense australiense* Holthuis
— Rostrum above convex at base, concave at apex, apex distinctly upturned; carpus about equal to palm; carpus five times as long as wide; fingers almost as long as palm .... *australiense crassum*, nov

Macrobrachium rosenbergi (de Man), 1879.

(Figures 6 and 12.)

Palaemon carcinus auctt. (non Linnaeus, 1758).
Palaemon Rosenbergii de Man, 1879, Notes Leyden Mus. 1, 167.
Palaemon (*Eupalaemon*) *carcinus rosenbergi* Roux, 1933, Rev. Suisse Zool. 40, 344.
Macrobrachium rosenbergii Holthuis, 1950, Siboga Exped. 39, Decapoda 10, 111.

Roux records the species from the Katherine River, north Australia.

Description of Adult Male (*Australian Material*).—Telson with apex long, acuminate, the lateral spines not reaching the apex of the telson; rostrum rather long and thin, with a sharply pointed apex, extending as far as or slightly beyond the antennal scale, more or less straight but with apex slightly upturned, lateral carina showing a more decided dorsal curvature; rostrum dorsally bearing eleven to thirteen teeth, the first three lying behind the orbit, the lower margin with eight spines, dorsal margin convex over the basal half, concave over the apical part, lower margin more or less straight for most of its length; second periopods very long and stout, coarsely but rather sparingly tuberculate, the tubercles lying in more or less regular lines; carpus considerably longer than the merus but not nearly half as long again; carpus about equal to the palm; fingers shorter than the palm, in some cases only about one-half as long as the palm; teeth of the proximal half of the cutting edges of the fingers quite small; dactylus densely clothed in short setae.

Australian Distribution.—Queensland: Coen; Norman River.

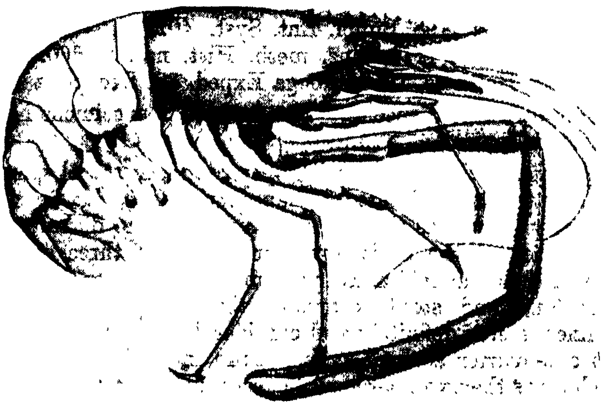


Figure 12.
Macrobrachium rosenbergi (de Man), J. R. Kinghorn, del.

This subspecies of large prawns can be distinguished from *Macrobrachium lar* described below from the Roper River by the structure of the telson, the tuberculation of the second periopods and the shape of the rostrum. I have reproduced a figure of this species prepared from specimen No. 4371 by J. R. Kinghorn. The rostrum generally has a slightly more upturned apex than represented.

Macrobrachium tolmerum, sp. nov.

(Figure 1.)

Description of Adult Male.—Telson with the apex short, acuminate, the inner of the lateral spines extending well beyond the apex of the telson; rostrum long, rather stout but with a sharply pointed apex, more or less straight but with a gentle upturning of the apex, deep in lateral view, particularly at the middle, the lateral carina showing a decided upward curvature; rostrum dorsally bearing eight to eleven teeth, usually ten, the first one to three teeth lying behind the orbit; three to four spines on the lower margin, dorsal margin definitely convex over at least the basal half, generally only slightly so, lower margin quite strongly convex; second periopods rather short and stout, rather finely, abundantly tuberculate; merus distinctly shorter than the carpus but at least three-quarters of it; carpus about as long as palm, fingers much shorter than palm, generally only half as long as palm; teeth of the proximal half of the cutting edges of the fingers quite small; carpus very narrowed at base, expanded at apex; fingers clothed with only short hairs; eggs very small and numerous, their length only 0·6 mm.

Length of adult male, 80 mm., length of adult female, 65 mm.

Types.—Holotype male (No. P.11988), allotype female (No. P.11989) and paratypes in the Australian Museum Collection.

Type Locality.—Black River, Macrossan, Queensland (October, 1943, E. F. Riek).

Distribution.—The species is known only from the type locality.

This species can be distinguished readily from the other small freshwater species on the size of the eggs and on the structure of the second periopods. On the size of the eggs one would be of the opinion that this was an estuarine species of the genus, but the specimens described above are from a purely freshwater habitat at least five miles above the tidal zone.

Macrobrachium lar (Fabricius), 1798.

(Figure 2.)

Palaemon lar Fabricius, 1798, Suppl. Ent. Syst., 402.

Palaemon ornatus Oliver, 1811, Enc. meth. Hist. nat. 8, 660.

Macrobrachium lar Holthuis, 1950, Siboga Exped. 39, Decapoda 10, 176.

This is a widely distributed species. The Australian specimens have a longer, more curved rostrum than is typical.

Description of Adult Male.—Telson with apex rounded, lateral spines short; rostrum rather short and stout, with a decided S-shaped curvature, the apex upturned, lateral carina not as strongly curved as the rostrum itself, rostrum dorsally with eight spines, the first two lying behind the orbit, lower margin with three spines, dorsal margin strongly convex over the basal half, apical portion concave, lower margin strongly convex; second periopods long and stout, coarsely, abundantly tuberculate but with the tubercles rather fine; merus definitely and considerably longer than the carpus, in some specimens about one-quarter as long again; palm much longer than either carpus or merus, almost as long as the two together; fingers much shorter than the palm, generally less than half its length; teeth of the cutting edges of the propodus and dactylus extremely large, propodus with tooth towards its base but dactylus with a still larger tooth about its middle, in addition, rudiments of two much smaller teeth more basad in some specimens; fingers devoid of obvious setae but external surface of dactylus densely clothed in short, stout spines.

The only definite Australian locality is the Roper River, north Australia. The type of *ornatus* was most probably collected somewhere on the north-west coast of Australia. The species can be distinguished from *rosenbergi*, which occurs on the eastern side of the Gulf and in Cape York, on the structure of the second periopods and on the shape of the rostrum.

Macrobrachium adscitum adscitum, sp. nov.

(Figure 3.)

Description of Adult Male.—Telson with apex short, acuminate, the inner of the lateral spines extending beyond the apex of the telson; rostrum short, deep in lateral view, with the apex directed forwards and in a few specimens slightly upturned at apex, upper surface slightly convex, lateral carina with only a very slight dip in the middle, lower margin convex, rostral teeth prominent, dorsally with from eight to eleven, but typically eight or nine, lower margin almost invariably with three teeth, rarely four; second periopods long and thin, except for the greatly swollen palm, appearing smooth but very finely tuberculate; merus slightly greater than carpus; fingers with only short, though sometimes dense hairs; carpus almost equal to palm; fingers as long as or slightly longer than palm.

Length of adult male, 75 mm., length of adult female, 45 mm.

Types.—Holotype male, allotype female and paratypes (No. P.3095) in the Australian Museum Collection.

Type Locality.—Accommodation Creek, near Ballandean, Queensland.

Distribution.—Queensland : Accommodation Creek; Oakey.

This species is characterized by the very swollen palm to the otherwise very long and thin second periopods. In some respects it approaches *atactum ischnomorphum* but differs noticeably in the relative length of the carpus.

Macrobrachium adscitum, subsp.

There is a very distinct subspecies from Angus River, Strathalbyn, south of Adelaide, South Australia, which differs mainly in the unswollen palm of the second periopods. It has the distinctive very long merus of *adscitum adscitum*. As the material examined was not sufficiently well preserved the subspecies has not been described.

Macrobrachium glypticum, sp. nov.

(Figure 4.)

Description of Adult Male.—Telson with the apex very short, only slightly acuminate, the inner of the lateral spines extending well beyond the apex of the telson; rostrum rather short, pointed, extending straight out, apex not upturned, both upper and lower margins convex, upper only slightly so, not very deep in lateral view, with the lateral carina straight; dorsally the rostrum bears eleven or twelve, occasionally more, small, close, teeth, the first three or four lying behind the orbit, lower margin with three, more rarely four or two teeth; second periopods massive, obviously, though finely, tuberculate, tubercles larger on carpus and merus; fingers appearing bare, with only very short hairs; all segments of second periopods stout, merus distinctly longer than carpus, carpus much shorter than palm, which is a little longer than merus, fingers somewhat shorter than palm, carpus only three times as long as wide at apex, base only half width at apex; teeth on cutting edges of fingers very small.

Length of adult male, 48 mm., length of adult female, 42 mm.

Types.—Holotype male (No. P.11992), allotype female (No. P.11993) and three paratypes in the Australian Museum Collection.

Type Locality.—Coen, north Queensland (21 Nov., 1945, Wassell).

The female bears eggs of rather large size. One of the second periopods of the holotype male is quite small and bears numerous long setae, over all segments but particularly on the fingers. This species is very distinct, and, although it has a long merus as in *adscitum*, does not appear to be closely allied to that species. Its affinities would seem to be with some Asiatic species as are the other northern species of our fauna.

Macrobrachium atactum atactum, sp. nov

(Figure 5.)

Description of Adult Male.—Telson with apex short, acuminate, the inner of the lateral spines extending well beyond the apex of the telson; rostrum long, slightly convex above and without the apex slightly upturned, moderately deep in lateral view, with the lateral carina showing only a slight upward curvature, with the greater part of the rostrum lying above it; dorsally the rostrum bears seven to ten teeth, the first two or three lying behind the orbit, lower margin with three to five teeth, strongly convex; second periopods long and thin, appearing smooth, though very finely tuberculate; fingers appearing smooth, with only short hairs; merus almost equal to the carpus; carpus as long as palm; fingers not quite as long as palm; palm five to six times as long as wide at apex; teeth on the basal half of the cutting edges of the fingers moderately developed.

Length of adult male, 80 mm., length of adult female, 55 mm.

Types.—Holotype male (No. P.12007), allotype female (No. P.12008) and paratypes in the Australian Museum Collection.

Type Locality.—Conondale, Mary River, Queensland.

Distribution.—Conondale (25 Apr., 1943, E. F. Riek); Running Creek, Queensland-New South Wales Border (14 Apr., 1941, E. F. Riek); Sandy Creek, Moorooka, Brisbane (23 May, 1941, E. F. Riek); Mt. Coot-tha, Brisbane (18 May, 1941, E. F. Riek).

Macrobrachium atactum ischnomorphum, nov.

(Figure 6.)

Description of Adult Male.—Telson as in *atactum atactum* ; rostrum long and thin, extending almost straight out, upper margin almost straight, with a very slight upturning of the apex, not particularly deep in lateral view, with the lateral carina showing a definite upward curvature, with a little more than half the rostrum lying above it; dorsally the rostrum bears eight to ten teeth, the first two or three lying behind the orbit, lower margin with three to five teeth, moderately convex; second periopods long and very thin, appearing smooth though very finely tuberculate, fingers clothed in only very short hairs; merus almost equal to carpus; carpus generally longer than the palm but sometimes only equal to it; fingers longer than the palm; palm slightly swollen over its whole length; carpus seven times as long as wide; teeth on the cutting edges of the fingers usually quite small.

Length of adult male, 85 mm., length of adult female, 45 mm.

Types.—Holotype male (No. P.11995), allotype female (No. P.11996) and paratypes in the Australian Museum Collection.

Type Locality.—Elimbah Creek, Elimbah, Queensland (23 April, 1943, E. F. Riek).

Distribution.—Queensland: Elimbah; Waraba Creek, Caboolture (4 June, 1943, E. F. Riek).

This subspecies differs from the typical in the longer, thinner periopods with longer fingers and longer, less convexed rostrum which approaches that of *atactum sobrinum*.

Macrobrachium atactum sobrinum, nov.

(Figure 7.)

Description of Adult Male.—Telson as in *atactum atactum* : rostrum very long and thin, with the upper margin very slightly convexed over the basal half, apex very slightly upturned, rostrum moderately deep in lateral view, with the lateral carina showing a decided dorsal curvature so that the greater part of the rostrum lies above it; dorsally the rostrum bears nine to twelve teeth, usually ten, the first two or three lying behind the orbit, lower margin with three to five spines, generally five, strongly, evenly convex; second periopods long and thin, appearing smooth though very finely tuberculate; fingers clothed generally with dense but short hairs; merus almost equal to the carpus; carpus almost as long as the palm: fingers not quite as long as palm; carpus about six times as long as wide at apex; carpus rather more narrowed at base than in typical subspecies; teeth at bases of fingers small.

Length of adult male, 85 mm., length of adult female, 50 mm.

Types.—Holotype male (No. P.11998) allotype female (No. P.11999) and paratypes in the Australian Museum Collection.

Type Locality.—Muttaburra, Queensland (27 May, 1945, E. F. Riek).

Distribution.—Queensland: Muttaburra; Longreach (25 May, 1945, E. F. Riek); Diamantina River (November, 1931, J. R. Kinghorn). Northern Territory: Lawn Hill Creek; Avon Downs, near Camooweal (May, 1935, Troughton and Fletcher).

This subspecies differs from the typical in the larger rostrum and somewhat more hirsute fingers.

Macrobrachium australiense australiense Holthuis, 1950.

(Figure 10.)

Palaemon australis Ortmann, 1891 (non Guérin Méneville, 1838) Zool. Jb. (Syst.) v, 709.

Macrobrachium australiense Holthuis, 1950 (nom. nov.), Siboga Exped. 39, Decapoda 10, 174.

Ortmann described this species from a series of specimens from three different localities in Queensland (Gayndah, Rockhampton and Peak Downs). The typical subspecies is redescribed from material collected at Enoggera Creek, Brisbane.

Description of Adult Male.—Telson with the apex short, acuminate, the inner of the lateral spines extending well beyond the apex of the telson; rostrum moderately long, upper surface gently convex with only a slight upturning at apex, rather deep in lateral view, with the lateral carina almost straight but with a slight upward curvature at the apex, with a little more than half the rostrum lying above the carina; dorsally the rostrum bears eight to ten teeth, the first two or three lying behind the orbit, lower margin with three to five spines, moderately convex: second periopods rather stout, obviously though finely tuberculate; fingers clothed with long dense hairs; merus almost equal to carpus; carpus as long as palm; fingers much shorter than the palm, carpus five to six times as long as wide at apex; teeth of cutting edges of fingers only moderately developed.

Length of adult male, 65 mm., length of adult female, 55 mm.

Distribution.—Gayndah; Rockhampton: Peak Downs; Enoggera Creek, Brisbane (9 October, 1943, and 7 December, 1941, E. F. Riek).

This species differs from *atactum* noticeably in the structure of the periopods.

Macrobrachium australiense eupharum, nov.

(Figure 8.)

Description of Adult Male.—Telson with the apex short, acuminate, the inner of the lateral spines extending well beyond the apex of the telson; rostrum short, strongly convex above, apex almost without any upturning, deep in lateral view, with the lateral carina straight; dorsally the rostrum bears eight to ten teeth, the first one or two lying behind the orbit, lower margin with three or four spines, both the dorsal and ventral margins strongly convex; second periopods large, stout, obviously though finely tuberculate; fingers clothed with long, dense hairs; merus almost equal to carpus; carpus shorter than palm; fingers considerably shorter than palm; carpus four to four and one-half times as long as wide at apex; teeth of cutting edges of fingers moderately enlarged.

Length of adult male, 60 mm., length of adult female, 45 mm.

Types.—Holotype male (No. P.12001), allotype female (No. P.12002) and paratypes n the Australian Museum Collection.

Type Locality.—Burdekin River, Macrossan, Queensland (October, 1943, E. F. Riek).

Distribution.—Burdekin River (October, 1943, and January, 1942); Rosewood (February, 1944, E. F. Riek).

Ovigerous females were collected in October. This subspecies can be recognized readily by its very convex rostrum and the hirsute fingers of the finely tuberculate second periopods.

Macrobrachium australiense cristatum, nov.

(Figure 9.)

Specimens of this subspecies have been described and figured as a variety of *australis* by McNeill (1929).

Description of Adult Male.—Telson as in *eupharum*; rostrum short, convex above, apex not upturned, differs from *eupharum* in being slightly longer and thinner; second periopods large, very stout, propodus slightly swollen, obviously though finely tuberculate; fingers clothed with long dense hairs; merus almost equal to carpus; carpus shorter than palm; carpus four to four and one-half times as long as wide at apex, teeth of fingers generally quite large, limited to the basal half.

Length of adult male, 60 mm., length of adult female, 40 mm.

Types.—Holotype male (No. P.12004), allotype female (No. P.12005) and paratypes in the Australian Museum Collection.

Type Locality.—Pallal, Horton River, near Bingara, New South Wales.

Distribution.—N.S.W.: Pallal, Horton River and Johnstone River; Bourke; Narrabri, Namoi River; Junction Namoi and Barwon Rivers; Deniliquin; freshwater stream near Broken Hill; Wirrabilla Lagoon, Collarenebri; Riverina District; Cotter River, Australian Capital Territory; Murrumbidgee River, Australian Capital Territory.

This subspecies is very close to *eupharum* but differs slightly in the less convex rostrum though more obviously in the somewhat swollen palm of the very stout periopods and also less tuberculate periopods.

Macrobrachium australiense crassum, nov.

(Figure 11.)

Description of Adult Male.—Telson as in typical subspecies; rostrum long and rather thin, convex at base above but concave at apex, apex distinctly upturned, lateral carina with a slight upward curvature, with considerably more than half the rostrum lying above it; teeth of rostrum large, well spaced, eight or nine above, with two or three lying behind the orbit, three or four below, lower margin gently convex; second periopods large and stout, obviously tuberculate, more so than in the typical subspecies; fingers clothed with long, very dense hairs; merus almost equal to the carpus; carpus about equal to the palm; fingers almost equal to the palm; carpus five times as long as wide at the apex.

Length of adult male, 90 mm., length of adult female, 65 mm.

Types.—Holotype male (No. P.12010), allotype female (No. P.12011) and paratypes in the Australian Museum Collection.

Type Locality.—Cairns, Queensland (30 January, 1946, Wassell).

Distribution.—Cairns; Kuranda (16 August, 1942, I. S. R. Munro).

The specimens from Cairns were ovigerous. This is a very distinct subspecies which would probably best be considered a distinct species. The rostrum is so different and the periopods are more coarsely tuberculate and the fingers large and very densely hirsute.

Genus **Palaemonetes** Heller, 1869.

Subgenus **Palaemonetes** Heller, 1869.

Genotype, *Palaemon varians* Leach, 1814.

Mandible without a palp; branchiostegal spine present; supraorbital spine absent; propodus of fifth periopods with transverse rows of setae in the distal part of the posterior margin; outer margin of the uropodal exopod ending in a tooth and a movable spine.

Palaemonetes australis Dakin, 1915.

Palaemonetes australis Dakin, 1915, Proc. Zool. Soc. London, 572.

Palaemonetes australis Holthuis, 1950, Siboga Exped. 39 Decapoda 10, 10.

This is the only recorded Australian species.

Types.—Location of types not indicated.

Type Locality.—Northam (River Avon), Western Australia (W. J. Dakin).

Distribution.—Western Australia. Northam; Gin Gin Brook, 50 miles north of Perth; Bibra Lake; Serpentine River.

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THE FRESHWATER CRAYFISH (FAMILY PARASTACIDAE) OF QUEENSLAND

WITH AN APPENDIX DESCRIBING OTHER AUSTRALIAN SPECIES.

By E. F. RIEK.

Commonwealth Scientific and Industrial Research Organization — Division of Entomology, Canberra, A.C.T.

(Figures 1–13.)

Freshwater crayfish occur in almost every body of fresh water from artificial dams and natural billabongs (standing water) to headwater creeks and large rivers (flowing water). Generally the species are of considerable size and therefore easily collected, but even so many of the larger forms are unknown scientifically. This paper deals with all the species that have been collected from Queensland. It also includes a few species from New South Wales and other States. No doubt additional species will be found and some of the more variable series, at present included under the one specific name, will be further subdivided.

From Queensland nine species are described as new, making a total of seventeen species (of three genera) recorded from that State. The type localities of all but two of these species are in Queensland but some are not restricted to the State. Clark's 1936 and subsequent papers have been used as the basis for further taxonomic studies of the Australian freshwater crayfish.

In Queensland the most widely distributed genus is undoubtedly *Cherax*. Ten of the species belong to this genus. These crayfish prefer the lower altitudes and a few species are able to live in somewhat brackish water. When the creeks dry out they burrow down until they reach the level of the ground water and thus survive till further rains. One species, *punctatus* Clark, is stated to be terrestrial. Four new species are recorded for this genus. Specimens of *dispar*, sp. nov., of south-eastern Queensland prefer the lower reaches of creeks where there is an abundant growth of freshwater plants. A very distinct subspecies, *dispar elongatus*, is described from the lakes and creeks of Fraser Island. *C. robustus*, sp. nov., also from Fraser Island, has evolved most probably from *depressus*, sp. nov., of the mainland. *C. depressus* occurs with *rotundus* at Mt. Coot-tha, Brisbane. *C. rhynchotus*, sp. nov., from Mapoon, Queensland, shows affinities with the Western Australian species.

Four new species of *Euastacus* are described, making a total of seven species of the genus to be recorded from Queensland. *E. hystricosus*, sp. nov., occurs at the headwaters of the Mary River, while a second *valentulus*, sp. nov., was collected from Currumbin Creek. *E. sulcatus*, sp. nov., is widely distributed through the Lamington National Park and *cunninghami*, sp. nov., is recorded only from the Cunningham's Gap area.

The genus *Tenuibranchiurus*, gen. nov., is erected for the reception of a new species, *glypticus*, somewhat resembling an *Engaeus* but differing in branchial structure. The species occurs at Caloundra, very close to the ocean beach, and at Mt. Gravatt, Brisbane. Specimens prefer the "wallum" swamps, where they dig deep burrows up to 3 feet or so in length in the dark, very humic soil. At both localities specimens were associated with *Cherax rotundus* Clark.

Crayfish grow considerably after reaching sexual maturity, so it is well to keep this fact in mind when describing new species, for there are often slight modifications, more particularly in the development of spines on the body and of the great chelae, both in juvenile and senile stages.

Family PARASTACIDAE Huxley.

Key to Queensland Genera of the Family.

1. Stems of podobranchs without lateral, wing-like expansions; first abdominal somite without distinct pleura; plane of propodus and dactylus of great chelae vertical so that the dactylus pinches vertically down on to the propodus; telson entirely calcareous; branchial formula 18 + ep. .... *Tenuibranchiurus*

— Stems of podobranchs each produced laterally into a broad, wing-like expansion; pleura of first abdominal somite reduced in size but distinct; plane of propodus and dactylus of great chelae not vertical so that the dactylus pinches laterally down on to the propodus; posterior portion of the telson membranous; branchial formula 21 + ep. 2

2. Telson partially divided by a transverse suture; male genital aperture on a separately calcified papilla on the coxopodite of the fifth periopods; abdominal pleura spinose; rostral carinae tuberculate or spinose .... *Euastacus*

— Telson without partial transverse suture; male genital aperture on a complex, uncalcified papilla; abdominal pleura without spines; spines on rostral carinae limited in number or absent .... *Cherax*

Genus **Cherax** Erichson, 1846.

Genotype, *Astacus* (*Cherax*) *preissii* Erichson.

Telson without a transverse suture, posterior portion membranous; stems of podobranchs each produced laterally into a broad, wing-like expansion with the exceptions of that on the fourth periopods (that is, the most posterior podobranch); branchial formula 21 + ep.; abdomen without spines or tubercles; male genitalia a complex uncalcified papilla; plane of propodus and dactylus of first periopods not vertical; pleura of first abdominal somite distinct.

The branchial formula is often 20 + r + ep., the posterior arthrobranch of the seventh thoracic somite being virtually absent. This is definitely the condition in *dispar*, *albidus*, *rotundus*, *robustus* and *depressus*. In *bicarinatus* the posterior arthrobranchs of thoracic somites five, six and seven are all reduced.

Key to the Queensland Species of Cherax.

1. Rostrum with lateral spines (very small in *bicarinatus* and *destructor*) 2

— Rostrum without lateral spines 6

2. Areola narrow 3

— Areola wide, not greater than three times as long as broad 4

3. Rostral carina with a single small spine towards apex .... *destructor* Clark

— Rostral carina with two conspicuous spines towards apex .... *rhynchotus*, sp. nov.

4. Rostrum two times as long as broad at base; antenna not reaching beyond the telson; eyes small; rostral spines very small .... *bicarinatus* (Gray)

— Rostrum more than two times as long as broad at base; antenna reaching beyond the telson; eyes large 5

5. Rostral carinae extending to the level of the posterior end of the post-orbital ridge; rostrum three times as long as broad at base, with three lateral spines on each side .... *quadricarinatus* (von Martens)

— Rostral carinae extending only to the level of the anterior end of the post-orbital ridge; rostrum two and one-half to three times as long as broad at base, with only one lateral spine on each side towards the apex .... *dispar*, sp. nov.

6. Sternal keel blunt; lateral processes of sternal keel increasing in length considerably in the posterior somites so that the coxopodites of the fourth periopods are wide apart; rostrum slightly greater than two times as long as broad at base .... *albidus* Clark

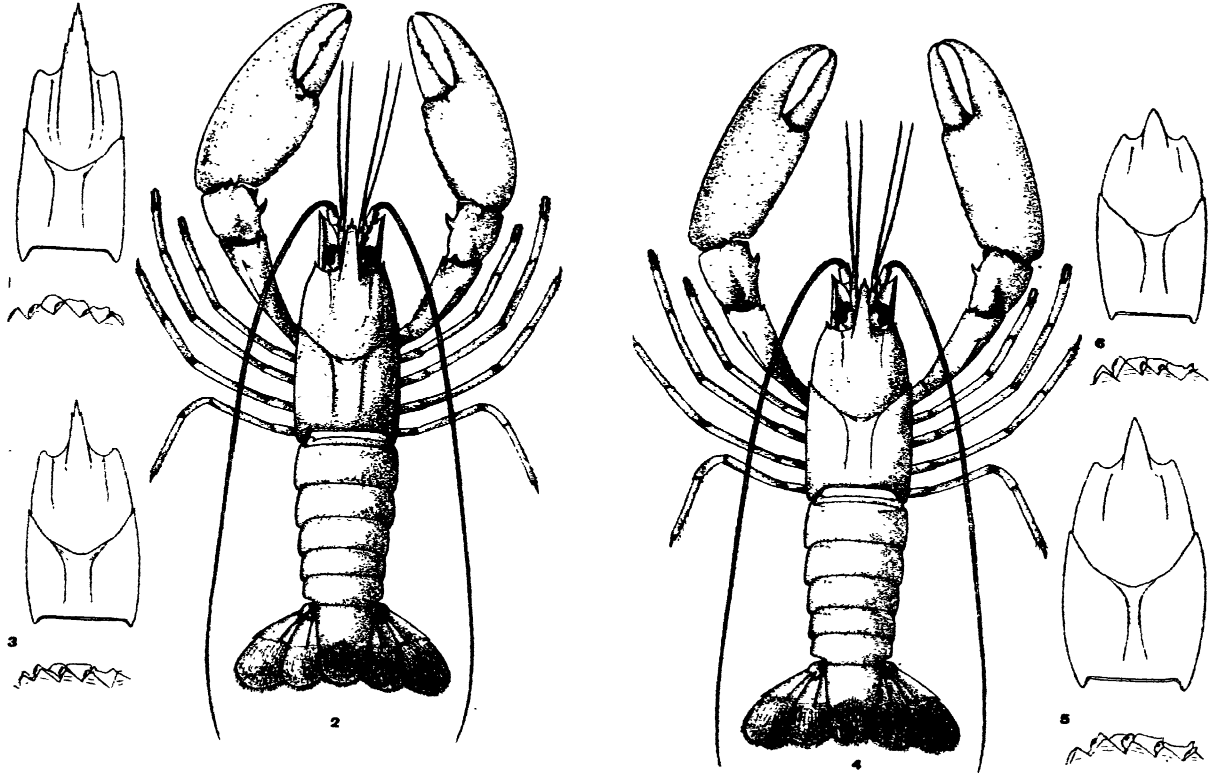
— Sternal keel sharp; lateral processes of the sternal keel increasing only slightly in length in the posterior somites; rostrum two times or less as long as broad at base 7

7. Rostrum two times as long as broad at base; areola four to six times as long as broad; sternal keel sharp, continuous .... *rotundus* Clark

— Rostrum two times as long as broad at base; areola three to four times as long as broad; sternal keel with a slight depression between the bases of the second and third periopods .... *robustus*, sp. nov.

— Rostrum two times as long as broad at base; areola six to eight times as long as broad; sternal keel with a deep depression between the bases of the second and third periopods .... *depressus*, sp. nov.

— Rostrum only slightly longer than broad at base .... *punctatus* Clark



Figures 1–6.

1. *Cherax quadricarinatus* (von Martens). Juvenile; from Batavia River. Cephalothorax (dorsal) and sternal keel (lateral view, with posterior end to left). 2. *Cherax dispar*, sp. nov. Holotype male. 3. *Cherax dispar*, sp. nov. Cephalothorax (dorsal) and sternal keel (lateral view). 4. *Cherax dispar elongatus*, nov. Holotype male. 5. *Cherax albidus*. Clark. Cephalothorax (dorsal) and sternal keel (lateral view). 6. *Cherax rotundus*. Clark. Specimen from Brisbane. Cephalothorax (dorsal) and sternal keel (lateral view).

All figures slightly less than natural size.

Cherax quadricarinatus (von Martens), 1868.

(Figure 1.)

Astacus quadricarinatus von Martens, 1868, Monats. Akad. Wiss., Berlin, 617.

Cherax quadricarinatus Clark, 1936, Mem. Nat. Mus., Victoria, x, 22.

This form is readily distinguished from the other Queensland species of the genus by the development of the carinae on the cephalothorax. The arcinae of the rostrum are continued posteriorly towards the cervical groove so that in that region four carinae are present, the two rostral carinae and the two post-orbital ridges.

Type Locality.—Cape York.

Distribution.—Batavia River, north Queensland (M. Ward); Richmond; Norman River; Telemon; Yirrkala, Darwin; Yam Creek, Darwin; Brooklyn Station, Mary River, tributary of Mitchell River (May, 1947, P. O. Flecker).

Specimens up to 210 mm. in length have been collected from the Norman River. Roux (1921) regards the species *Cheraps lorentzi* Roux 1911 as a synonym of *Cherax quadricarinatus* (von Martens). Clark (1936) considers both *lorentzi* and *aruanus* Roux as well as *albertsii* (Nobili) synonyms of *quadricarinatus*. A comparison of north Australian specimens with specimens from New Guinea shows that, in this case at least, we have well-defined subspecies. Material from Aru Islands has not been examined. The New Guinea subspecies can be distinguished by the stronger development of the rostral carinae which are continued almost to the cervical groove. This difference is quite pronounced even in juvenile specimens of the two subspecies. Also, the rostrum is relatively longer and thinner in the New Guinea subspecies.

Cherax dispar, sp. nov.

(Figures 2–3.)

Diagnosis.—Areola wide, two and one-half to three times as long as broad; great chelae seventy-five to eighty per cent. of the body length; eyes large, almost equal in diameter to the width of the rostrum at its base. The species can be separated readily from *rotundus*, with which it occurs at various localities, including the type locality, by the difference in the shape of the rostrum and the high cephalothorax, but more particularly by the wide areola and the relatively large eyes.

Description of Adult.—Carapace slightly higher than broad; cervical groove with one, but usually more, fine, sharply pointed spines on each lateral portion; areola wide, two and one-half to three times as long as broad; cephalic region of cephalothorax more than two times as long as areola; rostrum narrow, two and one-half to three times as long as broad at base, apex sharp, with a conspicuous sharp spine on each side towards the apex; post-orbital ridge sharp and somewhat raised, ending anteriorly in a well-developed sharp spine; eyes large, diameter almost equal to the width of the rostrum at its base; scaphocerite of antenna moderately broad, tending to be triangular, just reaching to the base of the flagellum of the antenna; antenna long, reaching beyond the telson; sternal keel moderately sharp, lateral processes increasing considerably in length in the posterior somites so that the coxopodites of the fifth periopods are wide apart; great chelae of the male long, typically seventy-five to eighty per cent. of the body length; propodus two and one-half times as long as broad; upper surface and cutting edge of propodus, cutting edge of dactylus and upper and lower surfaces of merus, covered with long setae; great chelae of female 65 to 70 per cent. of the body length.

Colour.—Light greenish-grey tending to blue on the abdomen, under surface almost colourless; great chelae blue on the upper surface, lighter in colour on the under surface. The chelae become blue only with maturity. Very young specimens (10 mm.) may be reddish and not bluish as is general.

Length of holotype male, 75 mm., length of allotype female, 65 mm.

Types.—Holotype male (No. P.11956), allotype female (No. P.11957) and paratypes in the Australian Museum Collection.

Type Locality.—Sandy Creek, Moorooka, Brisbane.

Distribution.—Sandy Creek, Moorooka, Brisbane; Enoggera Creek, Brisbane; Greenbank; Doughboy Creek, Brisbane; Caloundra; Cowan Cowan, Moreton Island.

Described from a series of two thousand specimens ranging in size up to 82 mm. body length, collected from the type locality, together with specimens from Moreton Island, Caloundra and Enoggera Creek, and a single specimen from both Greenbank and Doughboy Creek. The largest specimen is a female; females of only 50 mm. have been collected with eggs. The chelae of the immature male resemble those of the female in relative length. In the Moreton Island series the sternal keel is relatively blunt and the whole animal relatively longer and thinner. In the large series from the type locality there are many abnormal specimens. In these the rostrum is only slightly longer than broad at the base but the other features and appendages are of normal proportions. When the rostrum is broken off several ecdyses occur befoıe the normal condition is reached again so that in time the rostrum of each of these specimens would have assumed normal proportions.

Cherax dispar elongatus, nov.

(Figure 4.)

Diagnosis.—Areola wide; eyes large; great chelae 80 to 85 per cent. of the body length. This subspecies differs from *dispar* in the relative size and shape of the great chelae and in their texture. It also differs in the slightly reduced rostrum. The species was not associated with *robustus*, sp. nov., which occurs in other lakes on Fraser Island.

Description of Adult.—Similar to *dispar*; rostrum slightly shorter; scaphocerite of antenna not reaching to the base of the flagellum of the antenna; great chelae long, 80 to 85 per cent. of the body length; propodus three times as long as broad, smooth and glossy but very finely punctate; dactylus only one-third as long as propodus. The lower margin of the propodus is straight, not curved as in typical *dispar*. The female differs in that the great chelae are only 60 to 65 per cent. of the body length.

Colour.—Greenish on thorax and abdomen; great chelae deep green tending to almost black on the upper surface, lighter in colour below. In the Lake Boemingan series the body is grey tinged with green and has numerous fine white spots on the branchiostegites. The chelae vary from green to deep blue.

Length of holotype male, 70 mm., length of allotype female, 55 mm.

Types.—Holotype male (No. P.11959), allotype female (No. P.11960) and paratypes in the Australian Museum Collection.

Type Locality.—Lake McKenzie, Fraser Island, Queensland.

Distribution.—Lake McKenzie, Lake Boemingan and Rocky Creek, Fraser Island.

Described from a series of forty-five specimens ranging in size up to 80 mm. collected from the type locality, together with twelve specimens from Lake Boemingan and twenty specimens from Rocky Creek. The Lake Boemingan specimens approach the typical mainland form and probably represent a more recent migration from the mainland than do the Lake McKenzie specimens.

Cherax dispar crassus, nov.

Diagnosis.—Chelae similar to those of *dispar elongatus* but with the tip of the propodus not as strongly curved. Dactylus relatively shorter than in the typical form.

Description of Adult.—Similar to *dispar* ; rostrum slightly shorter and with the rostral spines generally smaller; great chelae long, 80 to 85 per cent. of the body length; propodus three times as long as broad, surface very finely punctate; dactylus only one-third as long as propodus. The margins of the propodus are almost parallel but the width increases slightly till the junction with the dactylus.

Colour.—Similar to the typical form but with the chelae tending to be green.

Length of holotype male, 70 mm.

Types.—Holotype male (No. P.11962) and paratypes in the Australian Museum Collection.

Type Locality.—Caboolture, Queensland.

This form approaches *dispar elongatus* in the shape and size of the great chelae. It has been collected only from the Caboolture region, but as it is only possible to distinguish the subspecies on fully-grown specimens, the range will, in all probability, be extended.

Cherax destructor Clark, 1936.

Cherax destructor Clark, 1936, Mem. Nat. Mus. Victoria, x, 26.

Diagnosis.—Sternal keel moderately sharp; areola narrow; rostrum two times as long as broad at base, apex sharp, with a spine on each side; carapace broader than high.

Type Locality.—Melbourne, Victoria.

Distribution.—Cape York; Rockhampton; Burnett River; Barron Falls; Dunk Island.

Clark records this species from the several localities in Queensland listed above. I have not seen specimens collected in Queensland. Collections from many of the north Queensland localities contain only specimens of *Cherax depressus*, sp. nov., a species most closely allied to *rotundus* but superficially resembling a juvenile *destructor*.

Cherax albidus Clark, 1936.

(Figure 5.)

Cherax albidus Clark, 1936, Mem. Nat. Mus. Victoria, x, 28.

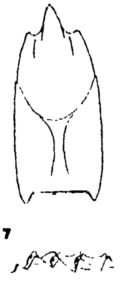
Diagnosis.—Sternal keel blunt; areola narrow, seven to eight times as long as broad; rostrum narrow, two to two and one-half times as long as broad. This species differs from *destructor* in the absence of lateral spines on the rostrum and in the relatively flat sternal keel with conspicuous openings on the lateral processes.

Description of Adult.—Carapace not quite as high as broad; areola narrow, seven to eight times as long as broad; cephalic region of cephalothorax less than twice as long as areola; rostrum narrow, two to two and one-half times as long as broad at base, apex sharp, without lateral spines; post-orbital ridge rounded; eyes small, diameter less than the width of the rostrum at its base; scaphocerite of antenna broad and rounded, not quite reaching to the base of the flagellum of the antenna; antenna not reaching beyond the telson; sternal keel blunt, lateral processes increasing only slightly in the posterior somites so that the periopods are not wide apart; great chelae stout, 75 per cent. of the body length.

Type Locality.— Nurrabiel, Victoria.

Queensland Distribution.—Eromanga; Longreach; Condamine; Chinchilla; Warrego River; Charleville; Diamantina River (billabongs); Essay, via Hughenden; Cunnamulla; Muttaburra.

This is the common species of crayfish of western Queensland. It is responsible for considerable damage to bore drains. The species has not previously been recorded from Queensland.



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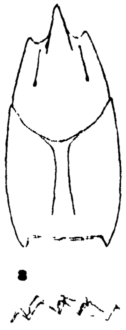

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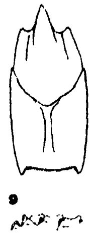

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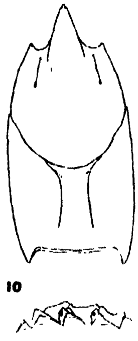

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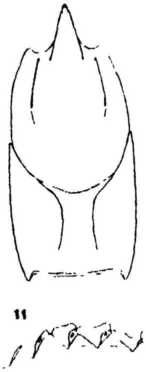

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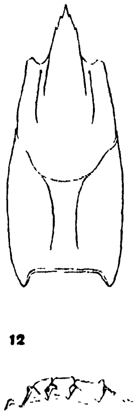

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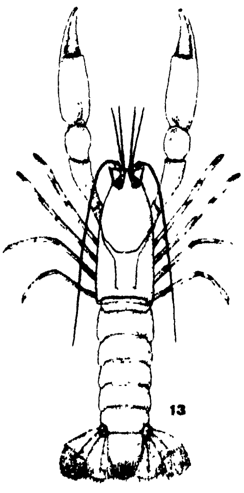

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Figures 7–13.

7. *Cherax depressus* sp. nov. Type series. Cephalothorax (dorsal) and sternal keel (lateral view). 8. *Cherax depressus*, var. Specimen from Gladstone. Cephalothorax (dorsal) and sternal keel (lateral view). 9. *Cherax depressus* var. Specimen from Cairns. Cephalothorax (dorsal) and sternal keel (lateral view). 10. *Cherax robustus*, sp. nov. Type series. Cephalothorax (dorsal) and sternal keel (lateral view). 11. *Cherax bicarinatus* (Gray). Specimen from Condamine. Cephalothorax (dorsal) and sternal keel (lateral view). 12. *Cherax rhynchotus*, sp. nov. Type series. Cephalothorax (dorsal) and sternal keel (lateral view). 13. *Tenuibranchiurus glypticus*, gen. et. sp. nov. Holotype.

All figures slightly less than x 2 diameters.

Cherax rotundus Clark, 1941.

(Figure 6.)

Cherax rotundus Clark, 1941, Mem. Nat. Mus. Victoria, xiii, 34.

Diagnosis.—Sternal keel sharp, continuous between the coxopodites of the second and third periopods; rostrum two times as long as broad at base, without lateral spines; areola narrow, four to six times as long as wide.

Description of Adult.—Carapace slightly higher than broad; areola narrow, four to six times as long as broad; cephalic region of cephalothorax less than twice as long as areola; rostrum broad, two times as long as broad at base, apex sharp, without lateral spines; post-orbital ridge sometimes ending anteriorly in a sharp spine; eyes small, diameter less than the width of the rostrum at its base; scaphocerite of antenna broad and rounded, not reaching the base of the flagellum of the antenna; antenna not reaching beyond the telson; sternal keel sharp, continuous, not depressed between the coxopodites of the second and third periopods; lateral processes of the sternum increasing only slightly in the posterior somites so that the fifth periopods are not wide apart; great chelae stout, typically 70 per cent. of the body length; propodus two times as long as broad.

Type Locality.—Muddy Creek, Severn.

Distribution.—Muddy Creek, Severn; Greenbank (J. Peberdy); Milmerran (C. F. Fysh); Cedar Creek Falls, Tambourine Mountain; Petrie; Dayboro; Caloundra; Lyra; numerous localities within a 10-mile radius of Brisbane.

This is the most common species of crayfish in south-eastern Queensland where it occurs in almost every creek, often in large numbers. In dry weather specimens of this species build a cone of excavated earth round the entrance to the burrow and in some cases actually seal the opening in this manner. A true gynandromorph of the species was collected from Milmerran. This is the only one throughout the whole collection of some four to five thousand specimens, though partial gynandromorphs are quite common.

Cherax punctatus Clark, 1936.

Cherax punctatus Clark, 1936, Mem. Nat. Mus. Victoria, x, 29.

This is described as a terrestrial species of *Cherax*, some of the specimens having been collected under a rotten log, others burrowing down several feet to ground-water level. The burrows are marked by large cones of excavated earth.

Type Locality. Coorari.

Distribution.—Coorari; Eumundi.

I have not examined specimens of this species but it is said to resemble *rotundus*. In dry weather *rotundus* also builds a cone of earth at the entrance to its burrow which may be quite removed from permanent water.

Cherax depressus, sp. nov.

(Figures 7–9.)

Diagnosis.—Areola narrow, six to eight times as long as broad; rostrum two times as long as broad at base, without spines, apex somewhat rounded; sternal keel sharp, with a deep depression between the coxopodites of the second and third periopods.

Description of Adult.—Carapace slightly higher than broad: areola narrow, six to eight times as long as broad: cephalic region of cephalothorax less than two times as long as areola: rostrum long, two times as long as broad, apex somewhat rounded, without lateral spines; post-orbital ridge blunt, ending anteriorly in a rounded boss; eyes small, diameter less than the width of the rostrum at its base; scaphocerite of the antenna broad and rounded, not reaching to the base of the flagellum of the antenna; antenna reaching to the telson; sternal keel sharp, but with a deep depression between the coxopodites of the second and third periopods, lateral processes not very long so that the coxopodites of the periopods diverge only moderately; great chelae stout, typically 65 to 70 per cent. of the body length; propodus two to two and one-half times as long as broad.

Colour.—Mottled grey with the joints red and the chelae tipped in red, or else blue-grey with the chelae tipped in red. The mottled grey is the more typical.

Length of holotype male, 80 mm., length of allotype female, 70 mm.

Types.—Holotype male (No. P.11964), allotype female (No. P.11965) and paratypes in the Australian Museum Collection.

Type Locality.—Mt. Coot-tha, Brisbane.

Distribution.—Mt. Coot-tha, Brisbane; Northbrook Creek, Brisbane Valley; Pullenvale; Eidsvold (Burnett River); Bundaberg; Gin Gin; Watalgan (M. Ward): Gladstone; Dunk Island; Cardwell; Herbert River; Cairns; Kuranda.

Described from a series of more than three hundred specimens from the type locality, together with numerous other specimens. The species occurs with *rotundus* at the type locality, but can be distinguished by the shape of the sternal keel, the general lack of spines on the body and the size of the chelae. The specimens from Bundaberg and Gladstone and further north may be sub-specifically distinct, as the sternal keel is not so deeply incised between the second and third periopods and the areola is somewhat narrower than in specimens from the Brisbane area. Clark (1936) records *destructor* from several localities in Queensland but an examination of material from some of the localities listed by that author has revealed the presence only of *depressus* or its variants. Superficially these two species are alike, but differ strikingly in the development of the sternal keel, that of *depressus* being much more strongly developed particularly between the third and fourth periopods.

Cherax robustus, sp. nov.

(Figure 10.)

Diagnosis.—Areola narrow, three to four times as long as broad; rostrum two times as long as broad at base, without spines, apex sharp; sternal keel sharp, with only a slight depression between the second and third periopods.

Description of Adult.—Carapace higher than broad. Areola narrow, three to four times as long as broad; cephalic region of cephalothorax two times as long as areola; rostrum broad, two times as long as broad at base, without spines but carinae pronounced and ending before the apex; post-orbital ridge ending anteriorly in a blunt spine; eyes small, diameter less than the width of the rostrum at its base; scaphocerite of antenna broad and rounded, not reaching to the base of the flagellum of the antenna; antenna reaching to the telson; sternal keel sharp and with only a very slight depression between the coxopodites of the second and third periopods; lateral processes not very long so that the coxopodites of the periopods diverge only moderately; great chelae of male long and stout, typically 80 to 85 per cent. of the body length; propodus two and one-half times as long as broad.

Colour.—Blue on the upper surface with the chelae deep blue to almost black.

Length of holotype male, 85 mm., length of allotype female, 80 mm.

Types.—Holotype male (No. P.11967), allotype female (No. P.11968) and paratypes in the Australian Museum Collection.

Type Locality.—Lake Birrabeen, Fraser Island.

Distribution.—Lake Birrabeen and Lake Tahwan, Fraser Island.

Described from a series of twenty-five specimens from Lake Birrabeen and twenty specimens from Lake Tahwan. Female specimens of this species lay their eggs in August.

The four species, *rotundus*, *depressus*, *punctatus* and *robustus* form a natural group. *Cherax rotundus* and *depressus* occur in association in the Brisbane area. The two species, though closely related, do not interbreed under natural conditions. To the south only *rotundus* appears to persist, while as one proceeds north, *depressus* becomes the dominant form, but the specimens are now no longer identical with those of the Brisbane area but show variation in the direction of *rotundus*, so that the Cairns and other north Queensland specimens can either be regarded as variants of *depressus* or of *rotundus*. For the present they have all been grouped as *depressus* until further collecting elucidates the complex. *Cherax robustus* of Fraser Island has most probably evolved from the mainland form through isolation. *Cherax rotundus* may or may not be specifically distinct from *punctatus* as the type descriptions are very similar; *rotundus* has similar burrowing habits to *punctatus* and with the drying up of temporary water masses specimens merely burrow down to ground-water level and so could quite easily be regarded as terrestrial if collected during a dry spell.

Cherax preissii (Erichson), and **Cherax bicarinatus** (Gray).

Some confusion has arisen regarding the specific identification of the two species *preissii* Erichson and *bicarinatus* Gray. The species *preissii* was described from south-west Australia, while the type locality of *bicarinatus* is Port Essington, Northern Territory. McCulloch (1914) in dealing with the Western Australian species describes two forms *preissii* and *preissii* var. *angustus* (McCulloch). His variety *angustus*, which is specifically distinct from his *preissii*, is recorded only from the south-west portion of Western Australia whereas the *preissii* of McCulloch is more widely distributed. In my opinion *preissii* of McCulloch is really *bicarinatus* Gray and *preissii* var. *angustus* McCulloch is specifically distinct. I have examined the type material of *preissii* var. *angustus* McCulloch in the Australian Museum and as McCulloch did not designate a holotype, I designate the single male specimen, Australian Museum Catalogue No. P.2749, as holotype, and No. P.2751 as allotype female. No. P.2750 is a paratype female (juvenile). The type of *preissii* is lost so one could regard the type specimens of McCulloch's variety as the neotypes of *preissii* and thus retain *preissii*, the genotype of *Cherax*.

Cherax bicarinatus (Gray), 1845.

(Figure 11.)

Astacus bicarinatus Gray, 1845, Eyre's Jour. Exped. Disc. Cent. Austral. (Appendix), 410.

Cheraps preissii McCulloch, 1914, Rec. West. Aust. Mus., i, 229.

Cherax bicarinatus Clark, 1936, Mem. Nat. Mus. Victoria, x, 23.

There is a doubtful record of this species from Queensland so I have given a description of the species based on this material.

Diagnosis.—Sternal keel sharp; areola wide, two and one-half times as long as broad; rostrum two times as long as broad at base, with two pairs of small, lateral spines towards the apex.

Description of Adult.—Carapace higher than broad; areola wide, two and one-half times as long as broad; cephalic region of cephalothorax greater than twice as long as areola; rostrum two times as long as broad at base, apex sharp, with two pairs of small lateral spines towards the apex; post-orbital ridge rounded; eyes small, diameter less than the width of the rostrum at its base; scaphocerite of antenna broad but tending to be triangular, widest in the middle, just reaching to the base of the flagellum of the antenna; antenna not reaching to the telson; sternal keel sharp, lateral processes increasing only slightly in the posterior somites so that the fifth periopods are not wide apart.

Type Locality.– Port Essington, Northern Territory.

Queensland Locality.—? Condamine.

Described from two male specimens collected at ? Condamine where they were associated with *albidus*. The two species are very readily distinguished by the rostrum and the width of the areola. This species differs from *destructor* in the width of the areola and the number of rostral spines. Whereas in *destructor* the areola is narrow- in *bicarinatus* it is very wide, being only two and one-half times as long as broad.

Cherax rhynchotus, sp. nov.

(Figure 12.)

Diagnosis.—Areola narrow, four to five times as long as broad; eyes small, diameter less than the width of the rostrum at its base; rostrum large, two times as long as broad at base, rostral carinae each with two conspicuous spines on the apical third.

Description of Adult.—Carapace slightly higher than broad; areola narrow, four to five times as long as broad; cephalic region of cephalothorax less than two times as long as areola; rostrum long and broad, two times as long as broad at base, apex sharp, with two pairs of prominent lateral spines, the posterior pair lying at the junction of the apical and middle thirds of the rostrum; post-orbital ridge prominent, ending anteriorly in a sharp spine; eyes small, diameter less than the width of the rostrum at its base; scaphocerite of antenna moderately broad, widest in the middle or slightly towards base, just reaching to the base of the flagellum of the antenna; antenna reaching to the telson; sternal keel very sharp, slightly excavated between the second and third periopods, lateral processes of the keel not prominent. Chelae are absent from all except the allotype female and even in that case both are regenerating.

Length of holotype male, 85 mm., length of allotype female, 82 mm.

Types.—Holotype male, allotype female and seven paratypes in the Australian Museum Collection (No. P.4237).

Type Locality.—Mapoon, Queensland.

Described from a series of nine specimens from the type locality. There are both male and female specimens but a high percentage are intersexes. The species is allied to *bicarinatus*, but can be distinguished on the shape of the rostrum and the width of the areola. The areola is considerably wider in *bicarinatus*. The rostrum in *rhynchotus* is relatively longer, though broader and the two spines on each rostral carina are distinct, with the posterior one lying approximately at the junction of the apical and middle thirds. In *bicarinatus* the small spines are both more or less apical. There are three juvenile specimens from the Fly River, New Guinea, in the Australian Museum collection which are provisionally referred to this species.

Genus **Euastacus** Clark, 1936.

Genotype, *Euastacus elongatus* Clark, 1941.

Telson with the lateral margins divided by a transverse suture, membranous posteriorly; stems of podobranchs each produced laterally into a broad, wing-like expansion with the exception of that of the fourth periopods; branchial formula 21 + ep.: abdomen with spines and tubercles, sometimes restricted to the pleura; male genitalia a simple, separately calcified papilla; plane of propodus and dactylus of first periopods not vertical; pleura of first abdominal somite distinct.

The chelae vary in relative size and shape in the same individual as well as in growth stages so that their relative proportions are unsatisfactory specific characters. The genus is separated from *Astacopsis* chiefly on the structure of the gills. *Euastacus fleckeri* approaches *Astacopsis* in the reduction of the spines on the abdomen. The chief specific characters for *Euastacus* are the relative proportions of the rostrum, the tubercles of the branchiostegites and the spines of the abdomen, particularly those of the sixth somite, telson and uropods.

Key to the Queensland Species of Euastacus.

1. **Rostrum almost two times as long as broad, apex sharp; post-orbital ridge ending anteriorly in a sharp spine ... 2**

Rostrum less than two times as long as broad, apex blunt and U-shaped; post-orbital ridge ending anteriorly in a slight boss 3

2. **Sixth abdominal somite, telson and uropods with numerous sharp spines; branchiostegites strongly tuberculate and with a dorso-lateral row of sharp spines; rostral carinae with three pronounced spines; three rows of spines on each side of the abdomen .... *hystricosus*, sp. nov.**

Telson without dorsal spines; branchiostegites finely tuberculate and hirsute; spines of rostral carinae usually numerous (4-5); three rows of spines on each side of abdomen .... *sulcatus*, sp. nov.

Telson without dorsal spines; branchiostegites strongly tuberculate; spines of rostral carinae numerous; two rows of spines on each side of the abdomen .... *valentulus*, sp. nov.

Telson without dorsal spines; branchiostegites strongly hirsute; spines of rostral carinae usually numerous (4); two rows of spines on each side of the abdomen .... *cunninghami*, sp. nov.

3. **Rostrum only slightly longer than broad, very much U-shaped; spines of the abdomen reduced to a single row on the pleural margins; branchiostegites with very few tubercles .... *fleckeri* (Watson)**

- **Rostrum moderately rounded; abdomen with three lateral rows of spines; branchiostegites strongly tuberculate ... *suttoni* Clark.**

There appears to be a definite correlation between distribution and evolution within the Queensland species of the genus. As one proceeds north from New South Wales one finds that the species are to be collected only from higher and higher altitudes. *Euastacus* occurs almost at sea level at Sydney; *E. sulcatus*, which ranges from northern New South Wales into Queensland, generally is not collected below 1,500 feet; *E. suttoni* occurs only above 2,500 feet, while *E. fleckeri* of north Queensland lives only above the 3,000-foot level. Correlated with this distribution based on altitude one finds that the rostrum is progressively shortened and the abdominal spines reduced from *sulcatus* through *suttoni* to *fleckeri*.

Euastacus sulcatus, sp. nov.

Diagnosis.—Rostrum V-shaped, two times as long as broad; branchiostegites finely tuberculate and hirsute; telson without spines on the dorsal surface or else with one or two poorly developed.

Description of Adult.—Carapace slightly shorter than abdomen (about equal in length to the abdomen in the male); areola wide, two and a half times as long as broad; cephalic region of cephalothorax two times as long as areola; carapace punctate; branchiostegites closely tuberculate and hirsute; rostrum V-shaped, just two times as long as broad; carinae spinose, four or five spines on each side; post-orbital ridge ending anteriorly in a sharp spine; antenna reaching at least to the middle of the abdomen; abdomen spinose; in addition to the marginal pleural spines a row of spines at the junction of the pleura with the somites. Further, on somites three, four and five there may be spines or tubercles between the two rows mentioned above. The marginal spines decrease in size posteriorly so as to be reduced to mere bosses on the last somites. Telson typically without spines on the dorsal surface, but with numerous setae; great chelae stout, typically 70 per cent. of the body length, strongly inflated in the male. Additional spines occur on the median surface of the propodus.

Colour.—In the adult, bright blue with a whitish shield on the dorsal surface of the carapace and with the apical regions of the chelae and periopods white; chelae with the basal regions deep blue on the upper surface, very much lighter in colour on the under surface. Specimens from Running Creek show red in place of the blue of the type specimens except in that the chelae tend to be bluish.

Length of holotype male, 175 mm., length of allotype female, 200 mm.

Types.—Holotype male (No. P.11921), allotype female (No. P.11922) and paratypes in the Australian Museum Collection.

Type Locality.—Binna Burra, Lamington National Park, Queensland (January, 1943, E. F. Riek).

Distribution.—Lamington National Park and Tambourine Mountain.

Described from a series of more than one hundred specimens ranging in size up to 235 mm. (female), mainly from Binna Burra. The Tambourine specimens show a slight reduction in the development of the spines of the abdomen. The uppermost series does not pass beyond the stage of bosses. This species has not been collected below an altitude of 1,500 feet. It shows a tendency to wander overland in the damp rain-forest and may thus pass readily from one river system to another. Females of only 120 mm. length have been collected with eggs, while males of only 90 mm. are sexually mature. Eggs are laid towards the end of November or in December.

Euastacus cunninghami, sp. nov.

Diagnosis.—Rostrum V-shaped, twice as long as broad; branchiostegites densely hirsute, not spinose or tuberculate; telson without spines on the dorsal surface.

Description of Adult.—Carapace slightly shorter than abdomen in female, about equal to it in male; areola wide, about twice as long as broad; cephalic region of cephalothorax twice as long as areola; carapace dorsally punctate; branchiostegites densely clothed with tufts of long setae, not obviously tuberculate; rostrum V-shaped, almost twice as long as broad; carinae spinose, four, rarely three or five, spines on each side; post-orbital ridge ending anteriorly in a sharp spine; antenna not reaching to the telson, only to the fourth abdominal somite; abdomen with only the pleura spinose, but the sixth somite is without spines or tubercles; in addition to the marginal pleural spines a row of bosses at the junction of the pleura with the somites. On somites three and four there may be a small spine mesad to the marginal pleural spine. Dorsal surface of the first three or four abdominal somites each shows a pair of small bosses; telson without spines on the dorsal surface but with numerous setae; great chelae relatively small.

Colour.—Dark reddish-black, lighter ventrally and at the joints; bosses on abdomen greyish-white; antennae reddish.

Length of holotype female, 135 mm., length of allotype male, 115 mm.

Types.—Holotype female (No. P.11929), allotype male (No. P.11930) and paratypes in the Australian Museum Collection.

Type Locality.—Western slopes of Cunningham's Gap, Queensland (23 October, 1948, E. F. Riek).

Described from a series of nine specimens. The two largest are females carrying eggs. The species is closely allied to *sulcatus*, but can be distinguished by the very hirsute branchiostegites and less spinose abdomen.

Euastacus valentulus, sp. nov.

Diagnosis.—Great chelae stout and somewhat inflated; rostrum two times as long as broad, tending to be U-shaped; branchiostegites strongly tuberculate; telson without spines on the dorsal surface; two rows of spines on each side of the abdomen.

Description of Adult.—Carapace slightly shorter than abdomen; areola moderately wide, two and one-half to three times as long as broad; carapace punctate; branchiostegites strongly tuberculate; rostrum two times as long as broad at base, sides almost parallel for the greater part, tending to be U-shaped, apex sharp; carinae of rostrum with a number of spines; post-orbital ridge ending anteriorly in a sharp spine; antenna reaching to the sixth somite of the abdomen; abdomen spinose; in addition to the marginal pleural spines a row of sharp spines at the junction of the pleura with the somites, but decreasing in size posteriorly; telson without spines on the dorsal surface; great chelae very stout, slightly inflated, typically 70 per cent. of the body length.

Colour.—Preserved specimens only. Chelae bluish.

Length of holotype male, 180 mm.

Types.—Holotype male and paratype male (juvenile) in the Queensland Museum Collection.

Type Locality.—Upper reaches of Currumbin Creek.

Described from only two specimens, the holotype and a smaller male.

Euastacus hystricosus, sp. nov.

Diagnosis.—Rostrum two times as long as broad, with three pronounced spines on each rostral carina; branchiostegites strongly tuberculate, with an irregular dorso-lateral row of sharp spines; sixth abdominal somite, telson and uropods with a number of sharp spines on the dorsal surface.

Description of Adult.—Carapace slightly shorter than abdomen; areola wide, two and one-half times as long as broad; cephalic region of cephalothorax two times as long as areola; carapace coarsely punctate; branchiostegites prominently tuberculate and with an irregular row of prominent sharp spines on the dorso-lateral portion; rostrum two times as long as broad, pointed, tending to be U-shaped; carinae of rostrum with three sharp spines; post-orbital ridge ending anteriorly in a sharp spine; antenna reaching to the sixth somite of the abdomen; abdomen spinose; in addition to the marginal pleural spines a row of sharp spines at the junction of the pleura with the somites. Further, except on abdominal somites one and two, there is a third row of spines lying between the two mentioned above. Sixth abdominal somite with numerous, scattered, prominent spines on the dorsal surface; telson with numerous, scattered, prominent spines similar to those of the sixth abdominal somite; inner rami of the uropods with two longitudinal rows of prominent spines, one median along the carina, the other towards the outer, lateral margin; outer rami with a single row towards the outer, lateral margin; great chelae stout, not inflated.

Colour.—Preserved specimens rather dark. Chelae reddish; branchiostegites whitish; dorsal surface of the abdomen almost black. The smaller specimen appears to have been greenish, particularly on the abdomen.

Length of holotype male, 230 mm., length of allotype female, 155 mm.

Types.—Holotype male and allotype female in the Queensland Museum Collection.

Type Locality.—Yabba Creek, Yabba, Queensland.

Distribution.—Yabba Creek, Yabba; Bon Accord Creek, Montville; Conondale (25 April, 1943, E. F. Riek).

In a juvenile specimen from Conondale the rostrum is quite pointed and there are four spines on the rostral carinae.

Euastacus suttoni Clark, 1941.

Astacopsis serratus McCulloch, 1917 (in part), Rec. Aust. Mus., xi, 237.

Euastacus suttoni Clark, 1941, Mem. Nat. Mus. Victoria, xiii, 18.

Separated from *E. sulcatus*, which occurs nearer the coast, chiefly by the form of the rostrum and the tubercles of the branchiostegites. The two species are closely related.

Types.—In the National Museum Collection, Melbourne.

Type Locality.—Wyberba, Queensland.

Distribution.—Wyberba; Stanthorpe; Glen Aplin.

Specimens occur only above 2,500 feet at Glen Aplin and are bright red in the adult state.

Euastacus fleckeri (Watson), 1935.

Astacopsis fleckeri Watson, 1935, Mem. Qld. Mus., x, 232.

Euastacus fleckeri Clark, 1941, Mem. Nat. Mus. Victoria, xiii, 19.

This form is distinguished from the other Queensland species by the short, broad, rounded rostrum and the poor development of spines on the abdomen.

Types.—Holotype in the Queensland Museum Collection.

Type Locality.—Root's Creek, north Queensland.

Distribution.—Root's Creek; Mosman River and its tributaries; Daintree River; Mt. Lewis near Cairns (H. Flecker).

This species does not occur below 3,000 feet.

Genus **Tenuibranchiurus**, gen. nov.

Genotype, *Tenuibranchiurus glypticus*, sp. nov.

Cephalothorax shorter than abdomen; carapace higher than broad; cervical groove deeply impressed, rounded; branchiocardiac grooves prominent; areola wide; rostral carinae reduced or almost absent; sternal keel narrow, posterior pair of lateral processes large and flattened; male genital aperture on an arcuate medial projection of the coxopodite of the fifth periopods. The aperture is on the ventral extremity of the projection. Abdomen slightly wider than cephalothorax, smooth, pleural margins of somites rounded; first abdominal somite with pleural portions very much reduced; telson without transverse suture, entirely calcareous; branchial formula typically 18 + ep.; stem of podobranch not produced into a wing-like expansion; pleurobranchs reduced, typically to one situated on the last thoracic somite.

This genus is separated chiefly on the branchial arrangement. The gill-structure approaches most closely to that of *Parastacoides* Clark in the reduction in size of the posterior arthrobranchs and in the number of pleurobranchs, but the trend has proceeded further in *Parastacoides* which has no pleurobranchs. In most specimens of *Tenuibranchiurus glypticus* there is only the somewhat reduced posterior pleurobranch but in some females there are three, quite pronounced pleurobranchs on the last three thoracic somites.

Tenuibranchiurus glypticus, sp. nov.

(Figure 13.)

Diagnosis.—Small; eyes reduced; cephalothorax higher than broad; abdomen longer than cephalothorax; great chelae 80 to 85 per cent. of the body length; propodus and dactylus lying in a vertical plane.

Description of Adult. Carapace finely punctate, branchiostegites finely tuberculate; carapace much shorter than abdomen, much higher than broad, two and one-half times as long as broad; cervical groove deeply impressed, very oblique laterally; branchiocardiac grooves strongly marked, not meeting the cervical groove dorsal but being carried antero-laterally just below it for some distance, posteriorly ending in small, irregular, transverse grooves just before the posterior border of the cephalothorax; areola wide, only a little more than twice as long as broad, sides almost parallel posteriorly; rostrum broad, reaching only to the base of the third segment of the antennular peduncle, one and one-half times as long as broad, carinae poorly developed and in some cases partly obsolete; post-orbital ridges very much reduced; eyes relatively small, slightly greater in diameter than one-half the width of the rostrum at its base; antennule with the inner and outer flagella of equal size; antenna extending to the third segment of the abdomen, scaphocerite very broad anteriorly, ending in a short, sharp spine reaching to the middle of the second segment of the antenna and extending just beyond the rostrum; inter-antennal spine triangular, sharply pointed; exopodite of the third maxilliped long and flagellate; sternal keel narrow, moderately sharp, first two pairs of lateral processes rudimentary, third pair small, posterior pair large and broad, slightly flattened, processes between the fifth periopods small, lateral processes of the sternal keel without conspicuous openings; abdomen slightly wider than cephalothorax; telson rounded, one and one-half times as long as broad, a blunt spine on each lateral margin towards the posterior border; uropods rounded, slightly longer than telson, each ramus with a longitudinal, median carina ending in a small spine towards the posterior margin, outer rami each with a transverse suture along which there are a number of very fine spines; telson and uropods bordered with numerous long setae; lobes at base of uropods rounded; pleural portions of abdominal somites each with a few, long, thin setae; great chelae long and stout, 80 to 85 per cent. of the body length, held so that the dactylus lies vertically above the propodus and not medially to it; propodus two and one-half times as long as broad (lateral view), viewed dorsally at least four times as long as broad, upper margin feebly tuberculate with several irregular rows of tubercles, lower margin smooth. The tubercles extend over the whole of the dorsal and lateral surfaces of the propodus decreasing in size towards the ventral margin. Dactylus one-third as long as propodus, upper margin very feebly tuberculate; cutting edges of propodus and dactylus each with one or two well-developed tubercles; upper margins of carpus and merus feebly tuberculate; podobranchs without lateral, wing-like expansions, anterior arthrobranchs much larger than the posterior ones. Typically there is only a single pleurobranch, situated on the last thoracic somite, but occasionally in the female there are three, more strongly developed pleurobranchs on the last three thoracic somites. In the female the great chelae are slightly smaller and the abdomen very slightly wider than in the male.

Colour.—Greyish-brown tending to bluish-grey on the great chelae.

Length of holotype male, 24 mm., length of allotype female, 24 mm.

Types. Holotype male (No. P.11970), allotype female (No. P.11971) and paratypes in the Australian Museum collection. One male paratype in the collection of Melbourne Ward.

Type Locality. Caloundra, Queensland.

Distribution.—Caloundra (E. F. Riek); Bulimba Creek, Mt. Gravatt, Brisbane (E. F. Riek).

Described from a series of twenty-one specimens ranging in size up to 26 mm. collected from the type locality together with two specimens from Bulimba Creek.

APPENDIX.—OTHER AUSTRALIAN SPECIES.

This part of the paper deals with a number of new species and with the distribution of the better known forms.

Genus **Euastacus** Clark, 1936.

Euastacus nobilis crassus, nov.

Diagnosis. Rostrum U-shaped, with a slight median spine, not twice as long as broad; branchiostegites closely tuberculate; abdomen almost devoid of spines except on the lateral margins of most pleura; telson without spines on the dorsal surface.

Description of Adult.—Male carapace equal in length to the abdomen (slightly less in female); areola wide, only twice as long as wide; cephalic region of cephalothorax more than twice as long as areola; carapace punctate, branchiostegites closely tuberculate and sparsely, finely hirsute; rostrum U-shaped, less than twice as long as broad at base, carinae with only a single or else two or three very slight tubercles, median apical spine short and blunt; post-orbital ridge ending anteriorly in a slight tubercle; antennae reaching only to the second segment of the abdomen; abdomen almost smooth, first segment with single pleural spines, second segment with a series (three to five, generally four) of sharp spines along the antero-lateral, pleural margin and a large rounded boss in the middle at the junction of the pleurum with the tergum, third and fourth segments with small, marginal pleural spines, fifth segment with the spine very reduced, sixth segment without a spine; telson and uropods without scattered spines on the dorsal surface but with tufts of setae; great chelae rather short, stout, propodus rather broad and inflated, carpus with a deep sulcus and three sharp spines on the meso-dorsal surface.

Colour.—Dorsal surface reddish-brown, cephalon darker; branchiostegites red; abdomen with anterior half of segments red, posterior darker, tending to black; chelae tipped with blue; joints red; spines not white but reddish; ventral surface red with ends of legs greenish, protopodites and sternal keel paler red, great chelae, below, tipped by deep blue. Young specimens are a much paler red below.

Specimens from Blundells, A.C.T., are of a different colour: Body blue-green; abdominal segments reddish over the anterior half, blue-green behind, blue laterally; claw of great chelae bright blue, underside of chelae white.

Length of holotype male, 115 mm., length of allotype female, 130 mm.

Types.—Holotype male (No. P.11937), allotype female (No. P.11938) and paratypes in the Australian Museum Collection.

Type Locality.—Small stream at Bendora, A.C.T. (12 March, 1949, E. F. Riek).

Distribution.—A.C.T.: Bendora; Blundells, Condor Creek (6 April, 1948, E. F. Riek). N.S.W.: Kosciusko (10 February, 1946, E. F. Riek).

The subspecies is described from a series of fifteen specimens from the type locality, the two largest females bearing young, together with three specimens from Blundells and a large series, with many juveniles, from Kosciusko. This subspecies, though close to the typical form, can be distinguished throughout all growth stages particularly by the more rounded rostrum. The branchiostegites are more tuberculate and the spination of the pleura and telson more reduced. There is a superficial resemblance to *fleckeri* (Watson) of north Queensland, but that species has an even more rounded rostrum and the cephalic portion of the cephalothorax is relatively short and the areola narrower.

Euastacus polysetosus, sp. nov.

Diagnosis.—Rostrum tending to be U-shaped, not twice as long as wide at base; branchiostegites finely hirsute; abdomen with only very small, marginal, pleural spines lacking on the first and sixth somites; telson and uropods with very fine spines on the dorsal surface.

Description of Adult.—Male carapace equal in length to the abdomen (slightly less in the female); areola wide, a little more than twice as long as wide; cephalic region twice as long as areola; carapace finely, closely punctate; branchiostegites finely, closely hirsute and shagreened; rostrum tending to be U-shaped, less than twice as long as wide at base, carinae with from two to four rounded spines similar to the apical spine; post-orbital ridge ending anteriorly in a slight tubercle; antenna reaching only to about the second segment of the abdomen; abdomen almost without spines, finely hirsute, particularly on pleura, first segment without spines, second with three (occasionally only two as in holotype), small, lateral pleural spines, third to fifth with single, even smaller, lateral pleural spines (very reduced in allotype female), sixth without spines; telson and uropods with scattered, very fine spines from which arise tufts of setae; great chelae somewhat inflated in male, carpus with a deep sulcus and three sharp spines on the meso-dorsal surface.

Colour.—Dark greenish to black, lighter in colour below; joints red; under surface of chelae reddish.

Length of holotype male, 105 mm., length of allotype female, 110 mm.

Types.—Holotype male (No. P.11917), allotype female (No. P.11918) and paratypes in the Australian Museum Collection.

Type Locality.—Tubrabucca Creek, Hunter River, Barrington Tops, N.S.W. (7 April, 1949, E. F. Riek).

Described from a series of fourteen specimens from the type locality. The species resembles *hirsutus* (McCulloch) in its lack of spines, even to those of the abdomen where the pleural spines are only well-developed on the second somite. The setae of the body, which are dense but very fine, are thickest on the branchiostegites.

Euastacus armatus (von Martens), 1866.

Specimens, tentatively placed in this species, from the Cotter River, near Canberra, A.C.T., approach *elongatus* Clark in the shape of the chelae, the spines of the rostrum and generally more strongly spinose body, but differ in the length of the antennae and spines of the telson. The normal adult size is only 150 mm. A series of nine specimens collected from the above locality (14 December, 1946, E. F. Riek).

With the new species of *Euastacus* described above there are six species known from New South Wales. In the Murrumbidgee and its smaller tributaries, *armatus* or possibly subspecies of it occur. In the far north coastal area one finds *sulcatus*, a widespread species in the Lamington National Park, south-east Queensland. Adequate collections have not been made in the central coastal area, but in the headwaters of the Manning juvenile specimens of the *sulcatus-spinifer* type occur. In the Hunter River at Barrington Tops is *polysetosus*, allied to *hirsutus* which occurs further south. The species *spinifer* is common in the Hawkesbury-Nepean system. In the Shoalhaven, in addition to *spinifer*, there is the distinct *hirsutus* known only from the headwaters. The species *nobilis* which prefers the smaller headwater streams and soakages is common around Sydney, while further inland at Bendora and Blundells in the Australian Capital Territory and at Kosciusko one has a distinct subspecies *nobilis crassus*.

The species *armatus* and *nobilis* occur also in Victoria with *elongatus* Clark, *yarraensis* (McCoy) and *bispinosus* Clark. There are no other recorded species of the genus in Australia.

Genus **Cherax** Erichson, 1846.

Cherax rotundus setosus, nov.

This subspecies differs from the typical form only slightly, but is characterized by the strong development of long setae on the under surface of the propodus of the chelae (first periopods). Such setae have not been observed on any species of this genus, so it is considered advisable to distinguish this form as a subspecies (of *rotundus*).

Length of holotype male, 80 mm.

Types.—Holotype male (No. P.4739) and one paratype male (No. P.4740) in the Australian Museum Collection.

Type Locality.—Booral, Karuah River, Port Stephens, N.S.W. (10 November, 1911).

There are also two juvenile specimens (P.4675) from a creek near Newcastle (May, 1907, D. G. Stead) in the Australian Museum Collection.

Cherax albidus Clark, 1936.

This species is common in Canberra, A.C.T. (21 December, 1948, 13 September, 1948, E. F. Riek). Females with eggs have been collected in September. Other localities are: Cotter River, A.C.T. (30 December, 1945, E. F. Riek); Laggan, near Crookwell, N.S.W. (12 April, 1946, E. F. Riek).

In a series of specimens of *albidus* from Koppio, near Todd River, 20 miles from Port Lincoln, South Australia, in the Australian Museum Collection, there is one very interesting abnormal specimen (P.4806). This particular specimen is an intersex of body-length 83 mm. which is apparently normal in all structures except in the placing of the genital apertures, which are four in number. It is not uncommon among specimens of the Australian Parastacidae to find intersexes with either three or four genital apertures. When three are present they are almost invariably two male and one female. In only one Australian specimen have I seen one male and two female apertures (in a specimen of *Cherax dispar*). When four are present (two male and two female), the male apertures are placed on the coxopodites of the fifth periopods, while the female apertures are placed similarly on the third periopods (the normal position of the apertures). In this specimen of *albidus*, while the two male apertures are placed normally, the two female apertures are quite abnormal in that they are situated on the fourth periopods, instead of on the third periopods and thus are on the segment next to the male apertures. These female apertures are quite well-developed and in no way distinguishable from normal apertures.

Genus **Engaeus** Erichson, 1846.

Engaeus parvulus, sp. nov.

Diagnosis.—Abdomen considerably shorter than cephalothorax; cervical groove obsolete, branchiocardiac grooves deeply impressed; areola narrow; carapace and abdomen with only scattered hairs; antennule with one flagellum reduced.

Description of Adult Male. –Carapace very finely punctate, branchiostegites smooth; faint transverse rugae between the reduced post-orbital ridges; carapace considerably longer than abdomen, much higher than broad; cervical groove only slightly impressed dorsally but more so laterally; branchiocardiac grooves strongly marked, not continued to the posterior border of the carapace; areola narrow, four times as long as wide, sides almost parallel posteriorly; rostrum short and broad, reaching to the middle of the third segment of the antennular peduncle, one and one-half times as long as broad, carinae poorly developed, generally not continued to the apex; post-orbital ridges very reduced; eye small, slightly greater in diameter than one-half the width of the rostrum at its base; antennule with the inner flagellum quite reduced, one-quarter to one-third (or a little more) the length of the outer flagellum; antenna not reaching to the abdomen; sternal keel broad and flat, posterior lateral processes quite large, processes between the fifth periopods small; lateral processes of the sternal keel without conspicuous openings; abdomen very short and narrow; telson rather pointed behind, one and one-half times as long as broad, with a slight median longitudinal sulcus; outer ramus of uropods rather pointed, inner ramus more rounded, each ramus with a longitudinal median carina turning to a sulcus before the hind border, outer ramus with an irregular transverse suture at the junction of the middle and apical thirds; lobes at base of uropods rounded; great chelae long and stout, slightly longer than the body, held so that the dactylus lies vertically above the propodus; propodus in lateral view only twice as long as broad, upper margin with five or six small sharp spines, lower margin with four or five denticles; dactylus slightly less than half the propodus, with one or two enlarged teeth on the cutting edge; carpus with three to five sharp spines; merus with two or three spines on the upper surface and several on the lower.

Description of Adult Female. - Similar to the male but abdomen considerably broader and relatively a little longer, the chelae of more even size, one not noticeably enlarged and not quite as long as the body.

Colour.—Bright red with slight darkening, in some specimens, of the branchiostegites and abdominal pleura.

Length of holotype male, 43 mm., length of allotype female, 47 mm.

Types.—Holotype male (No. P.11973), allotype female (No. P.11974) and paratypes in the Australian Museum Collection.

Type Locality. Blundells, Condor Creek, A.C.T. (31 March, 1948, E. F. Riek).

Described from a series of more than fifty specimens, though most of them are juvenile. This is the first species to be recorded from north of the Victorian border but the genus is widespread in Victoria and Tasmania.

Genus **Parastacoides** Clark, 1936.

Parastacoides setosimerus, sp. nov.

Diagnosis. Lateral spine of the telson at the apical fifth, apex evenly rounded; merus with a distinct spine on the upper surface towards the apex; carpus with distinct tubercles (three or more) on the meso-dorsal margin, anterior one largest; areola relatively narrow, twice as long as wide; spine on median longitudinal carina of inner rami of uropods almost at posterior margin, posterior border devoid of spines, outer rami with only one distinct longitudinal carina, continued across the suture only to the middle of the posterior portion and ending without spine, the outer carina distinct only over the basal quarter of the ramus.

Description of Adult.—Carapace very finely punctate, branchiostegites finely tuberculate; carapace not quite as long as abdomen (distinctly less in female), a little higher than broad; cervical and branchiocardiac grooves deeply impressed; areola relatively narrow, twice as long as wide; rostrum almost twice as long as wide at base, pointed, tapering more rapidly at apex; post-orbital ridges short and narrow, but sharp; eyes small, diameter slightly less than one-half the width of the rostrum at its base; antennule with the inner flagellum slightly shorter than outer; antenna not reaching to the telson; sternal keel blunt, wide and flat between the third and fourth periopods, lateral processes of the fourth periopods strongly angled so that there is a distinct groove between them; processes between the fifth periopods very small, close together; abdomen not quite as wide as cephalothorax (distinctly wider in the female); telson with apex evenly rounded, the lateral spine at the apical fifth, somewhat longer than wide; spine on median longitudinal carina of inner rami of uropods almost at the posterior margin, posterior border devoid of spines, outer rami with only one distinct longitudinal carina, continued across the suture only to the middle of the posterior portion and ending without spine, the outer carina distinct only over the basal quarter of the ramus; telson and uropods finely hirsute; great chelae evenly tuberculate, more so above on propodus and dactylus, carpus above with a slight sulcus, with distinct tubercles (three or more) on the meso-dorsal margin, the anterior one largest; merus with a distinct spine on the upper surface towards apex.

Colour.—Greenish with a reddish tinge; basal segments of all legs and third maxillipeds reddish, not so obvious on the posterior pair, basipodites bluish-grey, anterior cephalothorax and chelae somewhat lighter than the rest of the dorsal surface; joints whitish-grey.

Length of holotype male, 58 mm., length of allotype female, 70 mm.

Types.—Holotype male (No. P.11976), allotype female (No. P.11977) and paratypes in the Australian Museum Collection.

Type Locality.—Mt. Rufus, 4,000 feet, Tasmania (25 January, 1949, E. F. Riek).

Distribution.—Mt. Rufus and Lake St. Clair, Tasmania.

Described from a series of twenty-one specimens. The species approaches *tasmanicus* (Erichson) but differs at least in the structure of the telson and uropods.

Parastacoides leptomerus, sp. nov.

Diagnosis.—Lateral spine of the telson at the apical quarter, apex acutely rounded; merus with a minute spine on the upper surface towards apex; carpus with irregular small tubercles on the meso-dorsal margin, but no pronounced anterior tubercle; areola relatively broad, less than twice as long as wide; spine on the median longitudinal carina of the inner rami of the uropods well before the posterior border, posterior border devoid of spines; outer rami with a single long carina continued across the suture only to the middle of the posterior portion and ending without spine.

Description of Adult.—Carapace very finely punctate, branchiostegites very finely tuberculate; carapace a little shorter than abdomen, distinctly so in female, a little higher than broad; cervical grooves deeply impressed, branchiocardiac grooves less so; areola relatively broad, less than twice as long as wide; rostrum not twice as long as broad at base, evenly tapered to sharp apex, carinae sharp; post-orbital ridges rather long, sharp, each ending posteriorly in a distinct boss; eyes small, diameter slightly less than one-half the width of the rostrum at its base; antennule with the inner flagellum slightly shorter than the outer; antenna not reaching to the telson; sternal keel relatively sharp but rounded between the third and fourth periopods, lateral processes of the fourth periopods large, flattened, only a shallow groove between them, processes between the fifth periopods small, sharp; abdomen not quite as wide as cephalothorax (a little wider in the female); telson with apex acutely rounded, distinctly longer than wide, the lateral spine at the apical quarter; a faint, median longitudinal sulcus over the apical three-quarters; spine on median longitudinal carina of inner rami of uropods well before the posterior border, posterior border devoid of spines, outer rami with a single longitudinal carina continued across the suture only to the middle of the posterior portion and ending without a spine; telson and uropods finely hirsute; great chelae evenly tuberculate, more so above on propodus and dactylus, carpus above with a slight sulcus, with irregular small tubercles on the meso-dorsal margin but no pronounced anterior tubercle; merus with only a minute spine on the upper surface towards apex.

Colour.—Greenish with a reddish tinge; basal segments of all legs and of third maxillipeds reddish, not so obvious on posterior pair; lower surface of chelae greenish-grey, tips pale reddish; joints whitish-grey.

Length of holotype female, 53 mm., length of allotype male, 40 mm.

Types.—Holotype female (No. P.11979), allotype male (No. P.11980) and paratypes in the Australian Museum Collection.

Type Locality.—Lake Lilla and outlet stream, Cradle Mt., Tasmania (1 February, 1949, E. F. Riek).

Described from a series of seven specimens. The species differs from *setosimerus* in the structure of the telson and uropods, the areola and of the great chelae.

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STUDIES IN ICHTHYOLOGY.
No. 15.*

By Gilbert P. Whitley, F.R.Z.S.
Curator of Fishes, The Australian Museum, Sydney.

(Figures 1–14.)

Family GEOTRIIDAE.

Genus **Mordacia** Gray, 1851.
Mordacia mordax (Richardson, 1846.)

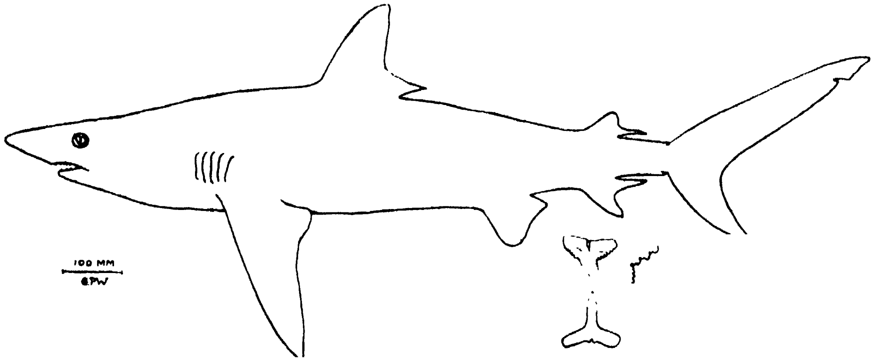
Mordacia mordax (Richardson) Whitley, Austr. Zool. vii, 1932, p. 262, pl. xiii, figures 9 and 10 and text-figures a (3 and 4).

Add to synonymy: *Petromyzon tasmaniensis* Lauterer (Australien and Tasmanien, 1900, p. 252), a hitherto overlooked name.

Family GALEIDAE.

Genus **Galeolamna** Owen, 1853.
Galeolamna tufiensis Whitley, 1949.

(Figure 1.)



Whaler Shark, *Galeolamna tufiensis* Whitley.
Holotype from Tufi, Papua. G.P.W. del.

Galeolamna tufiensis Whitley, Proc. Roy. Zool. Soc. N.S. Wales 1947–8 (Jan., 1949) p. 24, Tufi (type) and Port Moresby.

Head normal, predorsal profile not gibbous. Eyes rather large, subcircular, with nictitating membrane; pupil a vertical slit. Interorbital flat, slightly convex. Snout broadly rounded. Head 3 7 in total length. Preoral length less than width of mouth. No spiracle. Dental formula: $\frac{10\ ?.\quad 1.\quad 11}{13.\quad 1.\quad 12} = \text{c. } \frac{22.}{26}$ Teeth of upper jaw deflected; deeply notched on outer margin, shallowly on inner; strongly serrated on shoulders and serrated on cusps; generally broader than high. Teeth of lower jaw erect, entire, rather peg-shaped, higher than broad. A small symphysial tooth in each jaw; teeth on either side of the symphysial ones slightly smaller than other lateral ones. Nostrils nearer mouth than end of snout and nearer eye than end of snout. No nasal cirrhus. Labial folds very short. Endolymphatic openings inconspicuous. Last two gill-slits over pectoral.

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* For No. 14, see Records of the Australian Museum, Vol. xxii, no. 3, 27 January, 1950, p. 234.

Build heavy anteriorly and tapering posteriorly. Lateral line without flexure. No interdorsal ridge. Caudal peduncle rounded in transverse section with lunate pit above and below. Pit organs inconspicuous. No umbilical scar. Shagreen; denticles imbricate, each with several carinae.

Referring to the symbols listed in *Proc. Linn. Soc. N. S. Wales* (Whitley, 1943), the dimensions in mm. are as follow :—

Specimen.	A. Female Holotype.	B. Male Paratype.	C. Male Paratype.	D. Female Paratype.	E. Male Paratype.
H.1	320	144	143	143	500
2	392	172	170	166	630
3	123	54	63	64	207
4	171	75	71	72	330
5	385	170	165	163	c545
6	795	355	315	345	c1,340
7	28	16	17	17	22
8	24	15	15	17	25
9	168	74	72	76	308
10		-	-	(no spiracle)	—
11	21	11	11	10	34
12	99	45	43	43	165
13	104	59	56	56	153
14	143	62	60	60	270
15	8	4	2	2·5	10
16	9	5	3	2·5	10
17	48	23	20	20	99
18	43	23	16	18	96
B.1	1.101	522	485	495	1,890
2	850	365	350	360	1,430 ?
3	535	235	210	219	813
4	220	103	93	92	330 ?
5	c200	80	80	64	260 ?
6	49	27	24	26	99
7	49	25	22	24	101
8		14	14		185
9		18	14		260
F.1	178	97	95	94	390
2	139	63	62	64	300
3	57	28	30	29	110
4	320	164	138	139	560
5	65	31	32	31	145
6	56	26	27	26	130
7	58	26	28	25	82
8	95	53	41	48	185
9	90	38	38	36	160
10	64	28	29	30	120
11	54	26	25	26	80
12	82	49	39	45	130
13	–			-	-
14	296	123	120	119	510
15	83	36	33	34	205 ?
16	465	195	160	190	780
17	82	36	32	36	172
18	92	30	32	30	190
19	50	20	19	18	92
20	200	98	85	86	360
21	380	216	188	200	655
22	199	105	96	98	330

Additional measurements are : Total length, 1,481 mm. or about 4 ft. 10 in. overall. Second to fourth gill-slits subequal, about 54 mm. Eye to first gill-opening, 179 mm. Tip of snout to outer angle of nostril, 81 mm.; inner angle of nostril to mouth, 66 mm. Middle of vent to end of tail, 670 mm., and thus in posterior half of shark.

Fins as usual in Galeidae. First dorsal origin nearer pectoral (230 mm.) than ventrals (340 mm.). Second dorsal fin rather large, but smaller than anal. Origin of second dorsal slightly behind that of anal, and the end of its base slightly before that of anal (but in paratypes B and C, the origins and ends are about opposite). Pectoral angle reaching below first dorsal origin. Upper caudal lobe shorter than the head, the lower somewhat pointed.

Liver dark, weight 6 oz. Stomach contents too digested for identification, apparently some finely chopped seaweed. Spiral valve of the scroll type. Uteri flaccid; no embryos, so evidently had bred.

Colour, grey above, white below, the junction between the two on level of lowest part of eye and gradated along body. Fins dark grey above. Pupil dark blue with slight brassy ring and a smoky and brassy iris surrounded by grey rings. Nictitating membrane grey.

Described and figured from the holotype, a spent female, 1,481 mm. or 4 ft. 10 in. long and weighing 40 lb. 4oz. Austr. Mus. regd. no. IB.2334.

Locality : Off Tufi Harbour, North-eastern Division of Papua; hooked on long line, 1 October, 1948. M.V. " Fairwind " Fisheries Survey.

Variation.—The larger of two male paratypes (specimen B), with same data, is much smaller than the female holotype but agrees with it in most characters. However, the snout is more gothic-arched from the ventral aspect, there is a small pointed nasal lobe, the head goes 4·29 in total length and there is an umbilical scar, so it is probably a first-year immature shark. Total length, 738 mm. Weight, 4 lb. 3 oz. Liver weight, 7 oz. Stomach empty. Median rostral cartilage bifurcate ventro-anteriorly.

The smaller of the two male paratypes with same data as holotype (specimen C), is 673 mm. long. Weight, 3 lb. 3 oz. Head nearly 4 in total length. Very like specimen B but has almost lost the umbilical scar. Stomach empty. Liver whitish, weight 3 oz.

A small female paratype (specimen D), was actually caught on a line trolled at 4 to 4½ knots with garfish bait outside Feiaba Bay, near Tufi, Papua, on 4 October, 1948. Total length, 695 mm. Weight, 3 lb. 8 oz. Head 4·18 in total length. Dental formula $\frac{12.\ 1.\ 13}{13.\ 1.\ 13} = \frac{26.}{27}$ Umbilical scar present. Liver weight, 5 oz. Epigonal organ developed. Uteri mere strips. For heterogonic variation, see table of dimensions above.

An adult male paratype (specimen E), was caught on a meat bait at Port Moresby, Papua, on 5 November, 1948. It was 2,545 mm. or about 8 ft. 8 in. long. General characters as in Tufi specimens. Head 4 in total length, predorsal profile slightly gibbous; pupil lenticular; interorbital convex; endolymphatic openings well separated, 275 mm. from snout; nictitating membrane white; pit organs conspicuous. Dental formula $\frac{13.\ 1.\ 13}{10.\ 1.\ 13} = \frac{27.}{24}$ Origin and end of anal base behind levels of those of second dorsal. Upper caudal lobe longer than head. No interdorsal ridge. No umbilical scar. Claspers well developed. Liver weight, 35 lb., light-brown and in good condition. Stomach contained a pink, soft oily substance. Testes festooned all along coelome. Vesiculae seminales spent. Spiral valve of scroll type. Skin about 5 mm. thick; flesh tough and red at periphery. Eye to first gill-opening, 310 mm.; tip of snout to outer angle of nostril, 100 mm.; inner angle of nostril to mouth, 91 mm.; ramal length, 190 mm.

On 7 July, 1948, a " White Shark " was caught at Port Moresby but was not preserved. It was a female, doubtless of this species. Length, 9 ft. 2 in. Contained about a dozen embryos, 23 inches long, with yolk-sacs 2 inches in diameter. Liver very oily, weighed 42 lb. (Mr. A. M. Rapson, MS.).

This new species, which may be called the Tufi Whaler Shark, is distinguished from others in the genus mainly by its dentition (up to 27 teeth across jaw) and absence of an interdorsal ridge. The flesh is white and free from blood-streaks in small specimens and the species should be a potential food-fish.

Family RHENOPTERIDAE.

Genus **Rhenoptera** Van Hasselt, 1823.

Rhenoptera neglecta Ogilby.

Rhinoptera polyodon (*?*) Krefft, Industr. Progress N. S. Wales, 1871, p. 778. Australian coast (listed only). Not of Gunther.

Rhinoptera javanica De Vis, Proc. Roy. Soc. Qld. ii, 1886, p. 12. Moreton Bay, Queensland. Not of Muller and Henle.

Rhinoptera neglecta Ogilby, Mem. Qld. Mus. i, 27 Nov., 1912, p. 32, and of authors. Moreton Bay, Queensland. *Id.*, Whitley, Fish Austr., i, 1940, pp. 221 and 225, figs. 251 and 258.

Rhenoptera sp., Whitley, Austr. Zool. xi, 1945, p. 40. Carnarvon, W. Austr.

Three selected male specimens of this species were presented by Mr. Athel D'Ombrain who obtained them off Stockton near Newcastle, in April and May, 1949, and May, 1950. (Austr. Mus. regd. nos. IB. 2339, 2512 and 2513.) New Record for New South Wales.

Total length	990 mm.	1,060 mm.	1,130 mm.
Width of disc	890 mm.	880 mm.	936 mm.
Length of tail	460 mm.	510 mm.	580 mm.
Interorbital	120 mm.	142 mm.	151 mm.
Width of mouth	93 mm.	94 mm.	97 mm.
Preoral length	94 mm.	90 mm.	95 mm.
Internarial	75 mm.	75 mm.	74 mm.
Weight	24½ lb.	36 lb	30 lb.
Liver weight	—	3½ lb.	4 lb. 5 oz.

Skin smooth. Six or seven rows of teeth. 39 to 56 papillae along upper lip.

Family OPHICHTHYIDAE.

Genus **Malvoliophis** Whitley, 1934.

Cyclophichthys, subgen. nov.

Orthotype, *Ophichthus cyclorhinus* Fraser-Brunner, Ann. Mag. Nat. Hist., (10) xiii, 1934, p. 466, figs. 1*a–c*. Low Isles, Qld. = *M.* (*C.*) *cyclorhinus*.

A Snake Eel with pectoral fins present, gill-openings lateral, well separated, and snout short. Dorsal commencing before pectorals, instead of behind as in *Ophichthus*. Anterior nostrils cup-shaped; no fringe along upper lip. Anal fin ending just before tail-tip. Teeth conic, some on vomer. Crossbands on head and body.

Similar to *Malvoliophis* (*pinguis*), but that genotype has a perforated cone or tube for each anterior nostril and has the head spotted.

Family MURAENIDAE.

Lycodontis rhodocephalus (Bleeker, 1865.)

Gymnothorax rhodocephalus Bleeker, Ned. Tijidschr. Dierk., ii, 1865, pp. 50, 134 and 292. Amboina.

Two Queensland specimens (from Lindeman and High Islands) are in The Australian Museum. New record for Australia.

Family SYNGNATHIDAE.

Genus **Leptonotus** Kaup, 1853.

Kaupus, subgen. nov.

Orthotype, *Leptonotus costatus* Waite and Hale, Rec. South Austr. Mus., i, 1921, p. 301, fig. 43. South Australia.

Differs from the type of the genus (*Syngnathus blainvilleanus* Eydoux and Gervais, 1837) in having shorter snout and a ridge on the operculum anteriorly. It also apparently matures at about half the size of the more typical species of the genus.

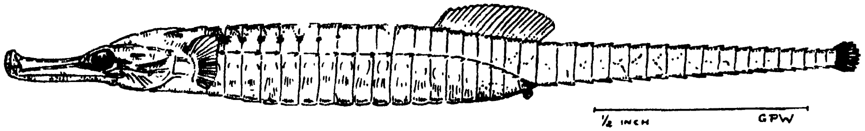
Genus **Choeroichthys.**

Choeroichthys suillus, sp. nov.

(Figure 2.)

D.21. A.5. P.18. C.10. Rings 18 plus 20. Subdorsal rings 5 plus 1. Brood-rings, 14, thoracic.

Eyes and nostrils projecting. Two complete opercular keels each side. No keels on shields between the body- or tail-ridges. Sculpture of shields striate, not reticulate. Spines on rings not serrate.



Pipefish, *Choeroichthys suillus* Whitley.
Holotype from Port Denison, Queensland. G.P.W. del.

Colour brown. Light and dark pattern on snout, chin and throat. Dark-brown bar through eye. A row of reddish spots along upper sides anteriorly. Three pairs of light blotches across back. Brood-pouch with dark scalloping over the light margin. Anterior two-thirds of caudal fin dusky-brown, posterior third yellowish. Other fins light yellowish.

Length, 2 inches. Port Denison, Queensland. Holotype, Austr. Mus. regd. no. IA.1806.

Differs from other species (see Weber and Beaufort, 1922, p. 60) in ring-counts and in lacking keels on rings between ridges.

Family HEMIRAMPHIDAE.

Genus **Reporhamphus** Whitley, 1931.

Reporhamphus caudalis, sp. nov.

Two small garfishes bore the manuscript name *Hemirhamphus caudalis* in The Australian Museum, probably having been so labelled by De Vis or Saville-Kent.

D. 16. A. 15.

Length of pectoral, 13 mm. Head (without beak), 21 mm. Preorbital, nearly 4 mm. Eye, 6 mm. Upper jaw about twice as wide as long.

Tricuspid teeth in up to four rows. Nostril openings large, without long barbel. Beak about one-sixth of total length. Dorsal originating before anal. Base of ventrals midway between root of tail and front part of operculum. Body rather compressed. Scales deciduous. Lower caudal lobe long, like that of a flying fish.

Colour in alcohol greyish to silvery. A silver patch around vent and stripe along side.

Length, 5¼ inches. Austr. Mus. regd. no. I.444 (holotype, larger, and paratype).

Cape York, Queensland.

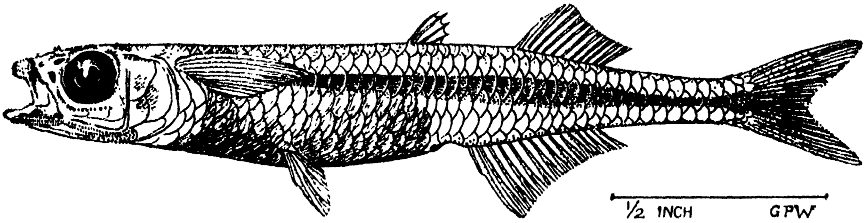
Family ATHERINIDAE.

Genus **Atherion** Jordan & Starks, 1901.

Atherion Jordan and Starks, Proc. U.S. Nat. Mus., xxiv, 4 Oct., 1901, pp. 199 and 203. Haplotype, *A. elymus* Jordan and Starks from Misaki, Japan.

Atherion maccullochi Jordan & Hubbs.

(Figure 3.)



Hardyhead, *Atherion maccullochi* Jordan and Hubbs.
A specimen from Low Isles, Queensland G.P.W. del.

? *Atherina villosa* Duncker and Mohr, Mitt. Zool. Mus. Hamburg, xlii, 1926, p. 135, fig. 10. New Pomerania and New Guinea.

Atherion maccullochi Jordan and Hubbs, Stud. Ichth. Monogr. Silversides (Stanford Univ.), 18 Dec., 1919, p. 30. Lord Howe Island. Types in Stanford Univ. *Id.*, Whitley, Sci. Rept. Gt. Barr. Reef Exped., iv, 9, 1932, p. 278 (Low Isles, Queensland). Here figured from one of the Queensland specimens recorded by me in 1932.

Genus **Atherinason** Whitley, 1934.

Atherinason Whitley, Vict. Nat., 50, 1934, p. 242. Orthotype, *Atherina dannevigi* McCulloch. *Id.*, Schultz, Proc. U.S. Nat. Mus., 98, 1948, p. 19.

Atherinason dannevigi verae, subsp. nov.

This is a hitherto unnamed northern form with D. viii/i, 12 and fewer lateral scales (sixty-three to seventy) than the Tasmanian type. Types (regd. no. IA.3247) in Australian Museum, from Port Jackson, New South Wales.

Family MUGILIDAE.

Mugil catalarum, sp. nov.

D. iv/i, 9; A.iii, 8,; P.i, 16; Sc.39 to hypural. Tr.16 below first dorsal to 9 on caud. ped. Predorsal sc.c. 22.

Head (37 mm.) 3·7, depth (41 mm.) 3·3 in standard length (138 mm.) or 4 2 in total length (175 mm.). Snout, measured obliquely, 9·5 mm.; eye, 10 mm.; interorbital, 17 mm.; postorbital, 19 mm.; pectoral, 26 mm.; depth of caudal peduncle, 15 mm.; axillary pectoral scale, 8·5 mm. Nostrils nearly 3 mm. apart.

Adipose eyelids well developed, partly overlapping pupil. Snout shorter than eye. Interorbital convex. Scales extend well forward on snout. Nostrils not widely separated, the distance between them equals rear end of preorbital which is denticulated. Maxillary exposed, reaching beyond free edge of preorbital and below front of eye. Upper lip terminal, slightly thickened; lower lip thin. Both lips with a row of simple teeth along edges. No palatal teeth. Lower jaw with symphysial crest.

Rostro-dorsal profile convex. Back not keeled. Scales cycloid with narrow membranous edges over which circuli extend; about 9 radii. Origin of first dorsal nearer caudal base than end of snout; origin of second dorsal about level of twenty-fifth scale;

second dorsal origin and end behind levels of those of anal; both these fins scaly anteriorly. First dorsal, pectorals and probably ventrals with axillary scales. Pectoral base level with eye, the fin much shorter than head and not reaching level of first dorsal, only extending to ninth or tenth body-scale. Ventrals more than half head. Caudal forked.

Colour in formalin greyish above, golden to yellowish on sides and white below. Scales each with a median dusky streak (above) or spot (below). Adipose eyelids pale yellowish; gold area on operculum. Fins mostly white with grey infuscations. A blue blotch over pectoral base. Eye bluish. Some yellow at anal and ventral bases and encircling vent.

Described from the holotype, a specimen 138 mm. in standard length or 175 mm. (nearly 7 inches) overall. Austr. Mus. regd. No. IB.2242.

Loc.—La Foa, River Bogny, west coast of New Caledonia; July ,1948. Dr. Réné A. Catala. Named in honour of Dr. and Madame Catala to whose collecting The Australian Museum is indebted for many interesting New Caledonian Fishes.

This species is near the "Frog-mouth Mullet" (*Mugil* sp.) figured from Kapakapa, Papua (Whitley, 1949, p. 342), but the mouth-opening is more acutely angled, snout shorter than eye, body deeper and the scales have narrow membranous edges.

The Papuan mullet is near *Mugil cephalus* Linné, 1758, and of authors, but differs from Cuvier and Valenciennes' plate 307 in having nostrils closer together and below upper level of orbit and in proportions (notably the broad interorbital); it also has most fins scaly. From *M. dobula* Gunther, 1861, it is distinguished by the obtuse (instead of acute) angle of the mouth-opening, has chin-space broader, fewer predorsal scales, etc. This Papuan variety may be described as follows :-

D.iv/i, 8; A.iii, 8; P.2, 14. Sc. 40 to hypural. Tr. 15 below first dorsal to 9 on caudal peduncle. Predorsal sc. 21.

Head (99 mm.) 3·7, depth (85 mm.) 4·4 in standard length (375 mm.) or 5·4 in total length. Snout (measured obliquely), 29 mm.; eye, 21 mm.; interorbital, 54 mm.; postorbital, 62 mm.; pectoral, 64 mm.; depth of caudal peduncle, 35 mm.

Adipose eyelids well developed, partly covering pupil. Maxillary not concealed. Snout longer than eye. Anterior nostril pore-like, posterior small, lunate, 10 mm. away. Interorbital convex. Preorbital serrae minute. Upper lip terminal, not particularly thick, protractile. Lower jaw with symphysial crest. Bands of fine "teeth" (cilia) in jaws and on palate. Cleft of mouth extending nearly to below eye. Chin-space wide. A broad opercular flap formed by the branchiostegal membrane.

Rostro-dorsal profile gently convex. Scales cycloid with broad membranous edges (or cilia may extend to edge) and few closely-bunched radii. Origin of first dorsal fin slightly nearer snout than root of caudal. Second dorsal, anal, pectoral and caudal fins scaly. Anal origin slightly before level of soft dorsal origin which is above the twenty-third or twenty-fourth lateral scale. Pectoral much shorter than head, reaching ninth body-scale, not reaching below first dorsal. Axillary scales present at first dorsal, pectorals and ventrals, that of pectoral (25 mm.) 2·5 in that fin; that of ventral about half that fin.

Colours in formalin greyish above, white below. Dark streaks along middle of lateral scales form stripes along body. Eye bluish with pale yellowish adipose membranes. A blue mark over pectoral base. Fins mostly dark grey. Pectoral and anal with whitish margins, ventrals white. Upper lip and maxillary grey.

Described from a specimen, 440 mm. in length to caudal fork, or a little over 18 inches (460 mm.) overall; weight, 1 lb. 15 oz. This was figured in "Australian Museum Magazine" (Whitley, 1949, p. 342).

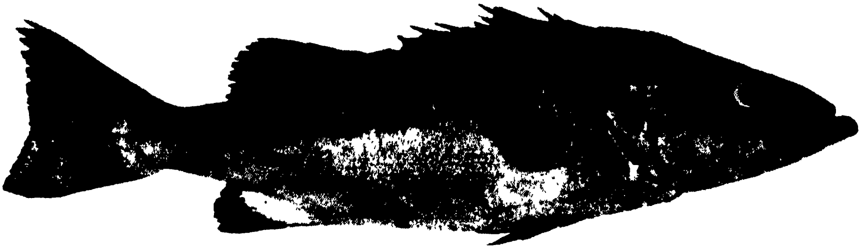
Loc.—Kapakapa, Papua; seine net haul in creek at village; 11 October, 1948. M.V. " Fairwind " Fisheries Survey. Field No. C.53. Another specimen, L.C.F. 24 cm. Same data. No. C.52.

Does not agree with any species in Weber and de Beaufort's " The Fishes of the Indo-Australian Archipelago", whose key-characters distinguish it.

Family EPINEPHELIDAE.

Polyprionum oxygeneios (Bloch & Schneider, 1801.)

(Figure 4.)

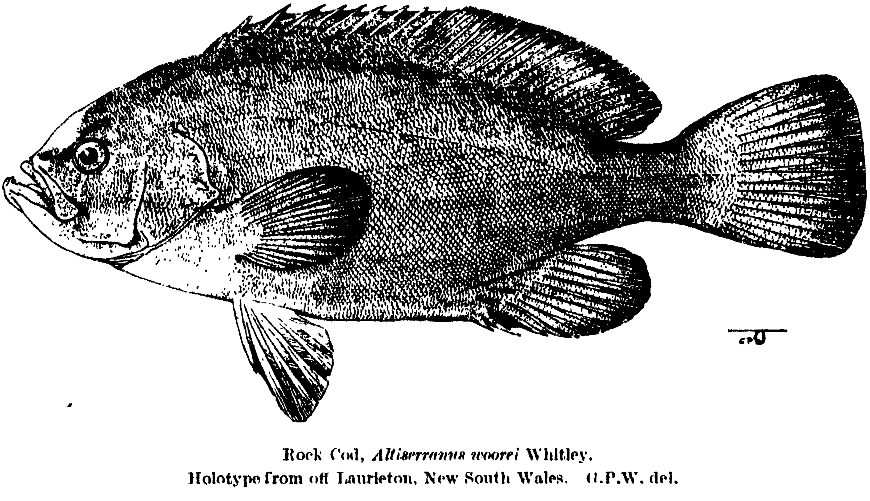


Hapuku, *Polyprionum oxygeneois* (Bloch and Schneider).
A specimen from Port Augusta, South Australia. South Austr. Museum photo.

The " Groper " or Hapuku of New Zealand is an important food fish which is occasionally caught in Australian waters. A 53-lb. specimen was recorded from the Hippolyte Rocks, Tasmania, by Saville-Kent in 1886. The F.I.V. " Endeavour " trawled specimens in the Great Australian Bight, between 100 and 200 fathoms, in Western Australia in March, 1912, and off the continental shelf of eastern Bass Strait, the latter constituting a new record for Victoria. The Hapuku may also be added to the South Australian fauna as a 3-foot specimen weighing 22 lb. was caught in Port Augusta in September, 1948, and was kindly sent to Sydney for my inspection by the Director of the South Australian Museum (Mr. H. M. Hale); this is the specimen figured here.

Altiserranus woorei, sp. nov.

(Figure 5.)



Rock Cod, *Altiserranus woorei* Whitley.
Holotype from off Laurieton, New South Wales. G.P.W. del.

A uniformly coloured rock cod with the compressed habit of *Alphestes*, *Aethaloperca*, *Altiserranus* and *Aulacocephalus*, but with 19 dorsal rays, an extraordinarily high number in the family, and diagnostic for the species.

D.xi, 19; A.iii, 10; V.i, 5.

Three opercular spines, upper one further removed from middle one than the latter is from the lowermost. Mouth reaching half-way below eye. Maxillary scaly, without distinct supplemental bone. Villiform teeth on vomer, palatines and jaws, slightly enlarged near symphyses, particularly two short blunt canines in lower jaw. Inner teeth depressible. Mandibular teeth uniserial. Both nostrils rounded.

Form compressed. Scales very small, ctenoid, those of l.lat. with simple tube. Third anal spine longest. Caudal truncate, other fins rounded.

Colour fairly uniform brownish-grey, not much lighter below, and darkest towards ends of fins. Eye dull blue with yellow ring and brown iris. Inside of mouth greyish-white. Interorbital grey, gelatinous.

Described from the holotype, a gutted specimen 14½ inches from snout to middle caudal rays. Austr. Mus. regd. no. IB.2489.

Loc.—Off Laurieton, New South Wales, late March, 1950.

Named after Mr. J. C. Woore, who has supplied The Australian Museum with rarities from the Sydney Fish Markets over many years, in appreciation of his services.

Family TERAPONTIDAE.

Genus **Leiopotherapon** Fowler, 1931.

Archerichthys, subgen. nov.

Orthotype, *Archeria jamesonoides* Nichols, 1949.

New name to replace *Archeria* Nichols (Nichols, 1949, p. 5) which is preoccupied by *Archeria* Case (Case, 1915, p. 170), a genus of reptiles. *A. jamesonoides* Nichols, although differing slightly in formulae, is evidently synonymous with my *Leiopotherapon suavis* (Whitley, 1948) from the same river system in northern Queensland. An illustration (Figure 6) of the holotype of *Leiopotherapon* (*Archerichthys*) *suavis* is here supplied.

Scortum ogilbyi, sp. nov.

The following description of a species near *S. hillii* (Castelnau, 1878), about 9 inches long, from the Norman River, Queensland, was originally prepared by the late James Douglas Ogilby, after whom it is now named. It was not separated from *hillii* in Ogilby and McCulloch's "Revision of the Australian Therapons" (Ogilby and McCulloch, 1916, p. 121, Norman River specimens only).

Jaws with a broad band of villiform teeth, and an outer series of close-set, recurved, movable teeth; a small patch of minute teeth on the vomer and an elongate triangular band of similar teeth along each palatine: pterygoids and tongue smooth. Preorbital and preoperculum both coarsely serrated. D.xiii, 12; A.iii, 8 to 10; P.16 to 17. Gill-rakers of moderate length, slender and numerous (8 + 16 to 11 + 24). As for *hillii*, the other differences between the Norman River fish and Castelnau's description are: His "back straight," ours ordinarily convex; his depth 3 in length (s.c.), ours 2·66; his eye 4·5 in head, ours 3·85 to 4; his l.lat. 61, ours 50 with sc. 73 to 75, and tr. 15 to 17/1/28 to 31; his caudal forked, ours probably subtruncate; his second anal spine as long as but stronger than the third, ours with second spine enormously enlarged, and one-fifth longer than third.

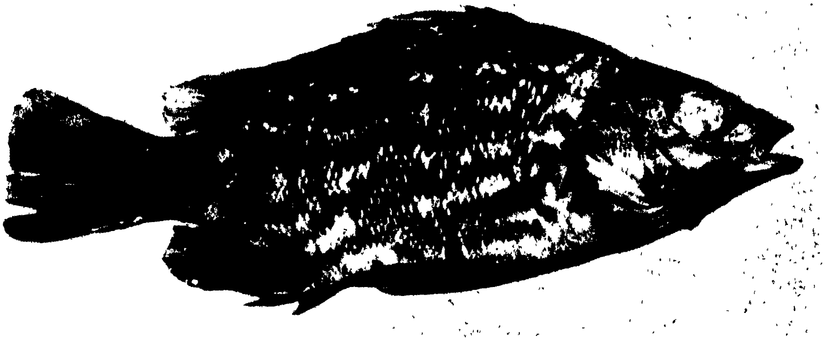


Fig. 6. — Grunter, *Leiopotherapon* (*Archerichthys*) *suavis* Whitley Holotype from Coen district, Queensland. H. Hughes photo.

Family AMTHIDAE

Anthias pulchellus caesiopercula, subsp. nov.

The typical *Anthias pulchellus* Waite, 1899, from deep water off New South Wales and Victoria, has D.x, 16 to 17; A.iii, 8; P. 15-16; l.lat. 41 to 45 and tr. about 5/1/13. From southern Queensland comes a new subspecies which I name *caesiopercula*. It was trawled by the F.I.V. "Endeavour," 5¼ miles N.E. of Cape Moreton in 50 fathoms, 5 September, 1910, and approaches the genus *Caesioperca* in its formulae which are: D.x, 18-21; A.iii, 7-8; P.14 (rarely 15); l.lat. 42-45 and tr. 6 to 8/1/16 to 18. The holotype (no. E.2878) and thirteen paratypes are unspotted, yellowish-brown in preservative with blue eyes, and range from 4 to 5 inches in length.

Lepidoperca occidentalis, sp. nov.

D.x, 15; A.iii, 7; P.15; C.15; l.lat. 43. Depth (30 mm.) 3·1, head (36 mm.) 2·6 in standard length (95 mm.). Snout about half eye (13 mm.) which is nearly 2·8 in head. Interorbital (9 mm.) 4·3 in head. Preorbital scaly. Maxillary barely reaching middle of eye, its width more than pupil. More than 23 gill-rakers. Second anal spine less than half head. Caudal emarginate, upper lobe longer. Colour in preservative pale-brown with blue eyes. In some there is a black blotch at tips of soft dorsal and anal fins.

Described from the holotype, the larger of two (no. E.2493) trawled by the F.I.V. "Endeavour" in Western Australia (between Cape Naturaliste and Geraldton in 20 to 100 fathoms). A paratype (Austr. Mus. regd. no. I.12494) with same data and another (I.12400) taken 80 miles west of the meridian of Eucla, Western Australia, 80 to 120 fathoms, March, 1912.

Reaches 4¾ inches in length. Differs in proportions, more concave caudal, more gill-rakers, and fewer fin-rays, etc., from its congeners: *L. coatsii* (Regan, 1913) from Gough Island; *L. inornata* Regan, 1914, from New Zealand; and *L. tasmanica* Norman, 1937, from Tasmania.

Family ACINACEIDAE.

Genus **Acinacea** Bory de St. Vincent.

Acinacea Bory de St. Vincent, Voy. iles Afriq., i, 1804, p. 93 (*fide* Sherborn) and Dict. Class. Hist. Nat., i, 1822, p. 93, pl. cv. Haplotype, *A. notha* Bory, 1804, from tropical Atlantic Ocean.

Gempylus Cuvier, Règne Anim. ed. 2, ii, April, 1829, p. 200. Haplotype, *G. serpens* Cuvier. Variants: *Gempris* Voigt, 1832 and *Gemphylus* Swainson, 1839.

Lemnisoma Lesson, Voy. Coquille, Zool. ii, 1, 1830, p. 160. Haplotype, *L. thyrsitoides* Less. from Paumotus.

Acinaces Agassiz, Nomencl. Zool. 1846, Index Univ. Emend. of *Acinacea*, not *Acinaces* Gerstacker, 1858, in Coleoptera.

Lemniscosoma Agassiz, Nomencl. Zool. 1846, Index Univ. Emend. for *Lemnisoma*.

Lucoscombrus Van der Hoeven, Handb. Dierkunde, Amsterdam, ii, 1855, p. 367 (*fide* Neave); Handbk. Zool. (trans. Clark) ii, 1858, p. 161. Logotype, *L. serpens* (Cuv.), selected by Whitley, Rec. Austr. Mus., xvii, 1929, p. 119.

The 27 to 32 dorsal spines distinguish this genus from all other "Gempylidae."

Acinacea notha Bory.

"*Serpens marinus*" Sloane, Voy. Jamaica, i, 1707, p. 26, pl. i, fig. 2. About Tropic of Cancer- *fide* Fowler, Acad. Nat. Sci. Phil. Monogr. vi, 1944, pp. 75, 295, 422, 463 and 499, pl. II (q.v. for synonymy, etc.).

Acinacea notha Bory de St. Vincent, Voy. iles Afriq., 1804, p. 93; Dict. Class. Hist. Nat., i, 1822, p. 93, pl. cv. Tropical Atlantic Ocean.

Gempylus serpens Cuvier, Règne Anim. ed 2, ii, April, 1829, p. 200. On Sloane. *Id.*, Valenciennes, Discip. ed., 1841, p. 121, pl. xlix, f.2. *Id.*, Gunther, J. Mus. Godeffr., 1873, pl. LXVIII, Figure B, and later authors.

Lemnisoma thyrsitoides Lesson, Voy. Coquille, Zool. ii, i, "1830" =1831, p. 160. Paumotus.

Scomber serpeas Cuvier and Valenc., Hist. Nat. Poiss., viii, "1831" = Jan., 1832, p. 208. *Ex* Solander, ms, Near Canary Islands, 22nd Sept., 1786.

Gempylus coluber Cuvier and Valenc., Hist. Nat. Poiss., viii, "1831" = Jan., 1832, p. 211. Tahiti.

Lucoscombrus serpens Van der Hoeven, Handb. Dierkunde (Amsterd.), ii, 1855, p. 367.

Gempylus ophidianus, Poey, Mem. Hist. Nat. Cuba ii, 1861, p. 246, pl. xviii, fig. 1. Cuba, *fide* Fowler, Proc. Acad. Nat. Sci. Philad. 1904, p. 767.

Acinacea notha has priority over the later synonyms.

Genus **Leionura** Bleeker, 1860.

The generic name *Thyrsites* was first formally introduced by Lesson (Voy. Coquille Zool. ii, 1, "1830" = 1831, p. 158, pl. xv. Haplotype, *T. lepidopodea* Cuvier MS. from Brazil and Atlantic Ocean), the earlier "Les Thyrsites" of Cuvier's Règne Animal (Ed. 2, ii, April, 1829, p. 200) being a vernacular name only.

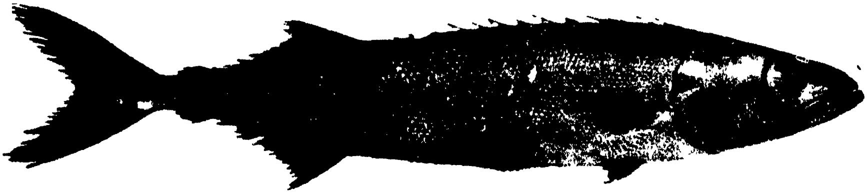
Thyrsites is usually quoted from Cuvier and Valenciennes (Hist. Nat. Poiss., viii, "1831" = Jan., 1832, p. 196, with *Scomber atun* Euphrasen as type) but Lesson's name, with *T. lepidopoidea* (Cuv. and Val. "1831" = Jan., 1832, p. 205, pl. 220) as genotype is earlier. *Thyrsitops* Gill, 1862 (type also *T. lepidopoidea*) thus falls as a synonym of *Thyrsites* Lesson and the *Thyrsites* of Cuvier and Valenciennes and authors (*non* Lesson), with genotype *T. atun*, may be called *Leionura* Bleeker (Nat. Tijdschr. Ned. Ind., xxi, 1860, p. 68, *ex* Kuhl and Van Hasselt, MS. Haplotype *L. esox* Bleeker = *Thyrsites atun* sensu lato); see Whitley (Rec. Austr. Mus., xviii, 1931, p. 150) for other synonymy.

Forest and Legendre, Bull. Inst. Oceanogr. Monaco, 966, 1950, pp. 5 *et seq*, have given a modern account of "*Thyrsitops lepidopoides*", which should now be called *Thyrsites lepidopodea* (Lesson).

Family RUVETTIDAE.

Ruvettus tydemani Weber, 1913

(Figure 7.)



Oil Fish, *Ruvettus tydemani* Weber.
A specimen from Victoria. H. Hughes photo.

Ruvettus tydemani Weber, Siboga Exped., lvii, Fische 1913, p. 401, pl. viii, fig. 4, Binongka Island, East Indies.

An Oil Fish or Palu was trawled in 50 fathoms, about 100 miles south of Gabo. Island, Victoria, in March, 1948. It has been recorded and illustrated in the Australian Museum Magazine (ix, 1948, p. 256 and figures) but the following technical characters are noteworthy.

D. xv, 17 plus 2; A.18 plus 2, its origin below second dorsal ray; P.2, 12, reaching below seventh dorsal spine; V.i, 5; C. with 15 branched rays. L.lat. *c*, 93; l.tr. *c*, 43 (14/1/28 behind pectoral); 34 abdominal scutes.

Head (203 mm.) 3·9 in length to caudal fork (805 mm.), height (148 mm.) 5 4 in same. Total length 34¾ inches, weight 8¼ lb. Depth of posterior nostril (6 mm.) about 6 in orbit. Twenty-six teeth in upper jaw.

Left eye : Horizontal diameter, 36 mm.; vertical diameter, 39 mm.

Right eye : Horizontal diameter, 37 mm.; vertical diameter, 41 mm.

Thus eye about 5 in head. Maxillary (111 mm.) barely reaching below posterior margin of eye; its depth, 18 mm. Snout, 70 mm.; interorbital (53 mm.) 3·8 in head; caudal peduncle 31 mm. wide and 35 mm. deep.

Austr. Mus. regd. no. IB.2039.

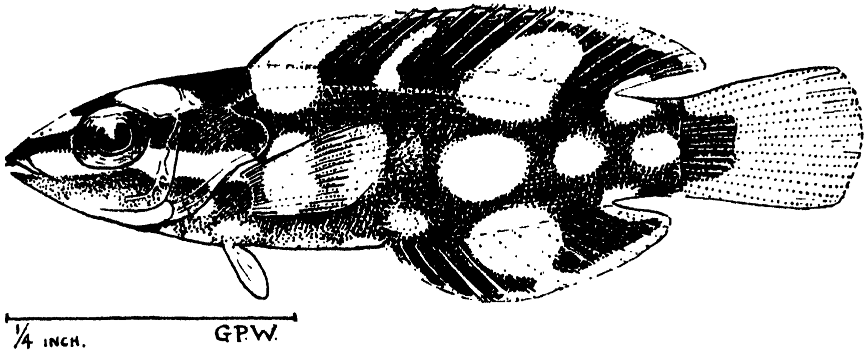
It differs from *R. whakari* (Griffin), 1927, p. 146, pl. xv, fig. 7. Bay of Plenty, New Zealand) in fin and scale-counts, in having a keel of abdominal scutes, spines extending some distance before the eyes, ventrals farther back in relation to pectoral base, and slightly different proportions.

Family CORIDAE.

Genus **Coris** Lacepede, 1802.

Coris cyanea Macleay.

(Figure 8.)



Double Head, *Coris cyanea* Macleay.
Juvenile from Lord Howe Island. G.P.W. del

Coris cyanea Macleay, Proc. Linn. Soc. N.S. Wales, vii, April, 1883, p. 588. New Guinea. Type in Australian Museum. *Id.*, Whitley, Austr. Zool., viii, 1937, p. 227, pl. xiii, Figure 3 (Middleton Reef).

Coris aygula Ogilby, Mem. Austr. Mus., ii, 1889, p. 68. (Lord Howe Island; changes with growth.) Not *C. aygula* Lacépède, 1802, from Mauritius.

The accompanying figure shows the smallest known Doublehead from Lord Howe Island. It is 0·73 inches overall and has the following characters.

D.ix, 12; A.iii, 12; P.2, 12; C.13. Though scales are developed, the l.lat. is not complete. Head (5·8 mm.) 2·5, depth (4 mm.) 3·6 in standard length (14·6 mm.). Eye (1·8 mm.) longer than snout depth of caudal peduncle, 2·3 mm.; pectoral, 3·5 mm.; total length, 18·5 mm. The ground-colour, after long preservation in alcohol, is chocolate-brown with light yellow spots on top of head, sides of body, and fins, as figured, and light yellow bands along sides of head. The ventral fin is inserted well forward and does not reach half-way to vent; the last anal rays are rather short. Austr. Mus. regd. no. IA.2419 (smaller specimen).

The Australian Museum has several larger specimens showing that this juvenile colour-phase, with some variation in pattern, occurs in fish up to at least 66 mm. in total length. These have D. viii to ix, 12; A.iii, 12; P.2, 12; C.12 to 13. L.lat. 63 to 65 to hypural (46 to 47 along top portion of l.lat.); l.tr. 4 to 5/1/25 to 28. There is of course no bump on the head. Ogilby (1889, p. 69), in an excellent review of the colour-variation with growth, mentions a 4-inch specimen which is not very different from the above juveniles.

It seems then that the Doublehead starts life in rock-pools and maintains this juvenile coloration until about 10 cm. long. The colouring is more uniform at 20 cm. or so, and the bump on the head probably does not develop before about 40 cm. The adult may reach 142·5 cm. and exceed 100 lb. in weight, a very different animal from the juvenile.

The Doublehead of Lord Howe Island has usually been named *Coris aygula,* one of Lacépède's species from Mauritius which has a number of nominal synonyms (see Weber and Beaufort, 1940, p. 247). The Australasian counterpart has been named *cyanea* by Macleay.

Klunzinger (1871, p. 539) was of the opinion that *Labrus cingulum* Lacépède was the young of *Coris aygula* and his lead has been followed by later authors except Ogilby, and Gunther (1909, pp. 279–280), so that two very differently coloured fishes, with identical fin and scale-counts, have been regarded as the young of *Coris aygula*, sensu lato. They differ as follows:

A. **Generally light-coloured with a couple of red saddle-marks on back and head dark-spotted. Dorsal fins with dark ocelli and other ornamentation** .... ***cingulum***

AA. **Dark-coloured with large light blotches. No dark spots on head. No marked ocelli on dorsal** .... **Lord Howe I. juveniles.**

According to Klunzinger, the *cingulum* form reached about 26 cm. and became *aygula* at about 30 cm., but Gunther (l.c.) gave *cingulum* a maximum of 10 inches and Bennett, in his "Fishes of Ceylon" says his *Labrus aureovittatus* (a synonym of *cingulum*) grows to 18 inches. J. L. B. Smith, in "The Sea Fishes of Southern Africa" (1949, p. 292, pl. 101, figure 806 and text-figure as juvenile *Coris angulata*) figures the *cingulum* form in colour and in line from specimens 4½ and 5 inches long. The smallest New Caledonian example of this form, from Dr. Catala, is about ¾ inch long and has the dark spots on the head, two red patches on the back each with black ocellus above on the dorsal fin, and a black crescent down the caudal base. Both *cingulum* and the juveniles I identify as *cyanea* are found at Lord Howe Island and specimens of the same length show the two very distinct patterns so that they are evidently separate species, and I consider that *cingulum* is a "good" species which should be removed from the synonymy of *aygula,* whereas the Lord Howe juvenile here figured is evidently the young of the Doublehead as identified by Ogilby. The late A. R. McCulloch, who collected this and other specimens, was of the same opinion.

Genus **Hemicoris** Bleeker, 1861.

Hemicoris pallida (Macleay).

Coris pallida Macleay, Proc. Linn. Soc. N.S. Wales, vi, July, 1881, p. 100. Endeavour River, Queensland.

Coris papuensis Macleay, Proc. Linn. Soc. N.S. Wales, viii, July, 1883, p. 275. South-east New Guinea.

Coris coronata De Vis, Proc. Linn. Soc. N.S. Wales, ix, March, 1885, p. 883. Murray Island, Queensland.

Hemicoris pallida Whitley, Gt. Barrier Reef Exped. Sci. Rept., iv, 9, 1932, p. 294, figure 4.

Coris papuensis and *C. coronata* are evidently hitherto unnoticed synonyms of the above species.

Family KRAEMERIIDAE.

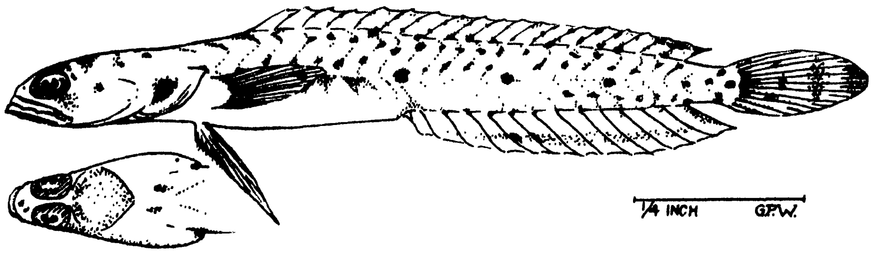
Parkraemeria, gen. nov.

Orthotype, *P. ornata*, sp. nov.

A genus of small sand-inhabiting fishes which comes down to *Kraemeria* in Schultz's key to the family Trichonotidae (Schultz, 1943, pp. 261–262) but differs from that genus in having the chin normal in form, not produced like a scoop, in having many more pectoral rays, and in its ornate coloration. Since Schultz's revision, Fowler (Fowler 1943, p. 86, figure 22) has named *Gobitrichinotus,* which has a longer trunk than *Parkraemeria* and other differences in proportions and pattern, and Beaufort (1948, p. 476) has described *Apodocreedia* which has no ventral fins and is very different in all respects.

Parkraemeria ornata, sp. nov.

(Figure 9.)



Sand Fish, *Parkraemeria ornata* Whitley.
Holotype from Narrabeen, New South Wales. G P.W. del.

Head (7 mm.) 3·8, depth (3·3 mm.) 8·1 in standard length (27 mm.). Trunk and head (14 mm.) more than tail without caudal (11·5 mm.). Pectoral length, 4 mm. Eye little over 1 mm. D.c. 4, 16; A.c. 12 ? P.c. 15. V.i, 5. C.c. 10. Myomeres 23. No l.lat.

Upper profile rounded, lower rather flat. Head naked. Eyes large. Interorbital very narrow with a mucus tube occupying almost all of it. Preoperculum round, spineless, striated; operculum with acute tip. Lower jaw projecting beyond upper. Mouth extending to behind eye, with a row of fine teeth in each jaw. No enlarged canines. Gill-slits wide, restricted to sides, separated by narrow isthmus. Form elongate, rounded anteriorly, compressed posteriorly. Body naked. No lateral line. Dorsal originating over hinder half of pectoral, ceasing before caudal peduncle. Paired and caudal fins pointed. Fifth (innermost) ventral rays longest.

Colour, pale brownish-yellow with conspicuous dark reddish-brown spots, widely spaced and irregularly shaped on head, body and fins, as figured. Four spots between mandibular rami, otherwise ventral surface is nearly all plain pale-yellowish. Five or six dark round spots along median line of side.

Described (and figured) from the holotype, a specimen 27 mm. in standard length or 33 mm. (1·3 inches) overall. Austr. Mus. regd. no. IA.3777.

Loc.—Narrabeen lagoon, near Sydney, New South Wales; netted by the author, December, 1928.

A slightly larger paratype (regd. no. I.8099), 1½ inches long, was obtained in the same lagoon by A. F. Basset Hull in 1907.

Family DIADEMICHTHYIDAE.

Genus **Diademichthys** Pfaff, 1942.

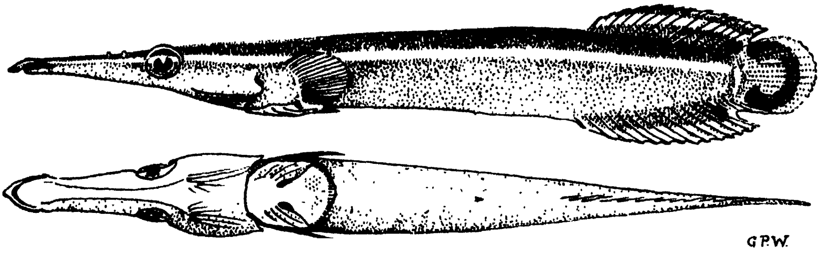
Diademichthys Pfaff, Vidensk. Medd. Dansk. nat. Foren., cv, 9 May, 1942, p. 413. Orthotype, *D. deversor* Pfaff.

Coronichthys Herre, Stanford Ichth. Bull., ii, 4, 24 August, 1942, p. 120. Orthotype, *C. ornata* Herre.

Pfaff's name has three months' priority over Herre's for this remarkable Clingfish which lives in the protection of sea-urchins.

Diademichthys lineatus (Sauvage).

(Figure 10.)



Clingfish, ***Diademichthys lineatus*** (Sauvage).
A specimen from New Caledonia. G.P.W. del.

Crepidogaster lineatum Sauvage, Bull. Soc. Philom. Paris, (7) vii, 1882, p. 158. New Caledonia.

? *Diademichthys deversor* Pfaff, *loc. cit.*, p. 413, pl. iii and text-figures 1–3. Java Sea and Mauritius.

? *Coronichthys ornata* Herre, *loc. cit.*, p. 122, figure 1. Coron, Philippines.

Diademichthys lineatus Whitley, Austr. Mus. Mag., x, 1950, p. 127 and figure.

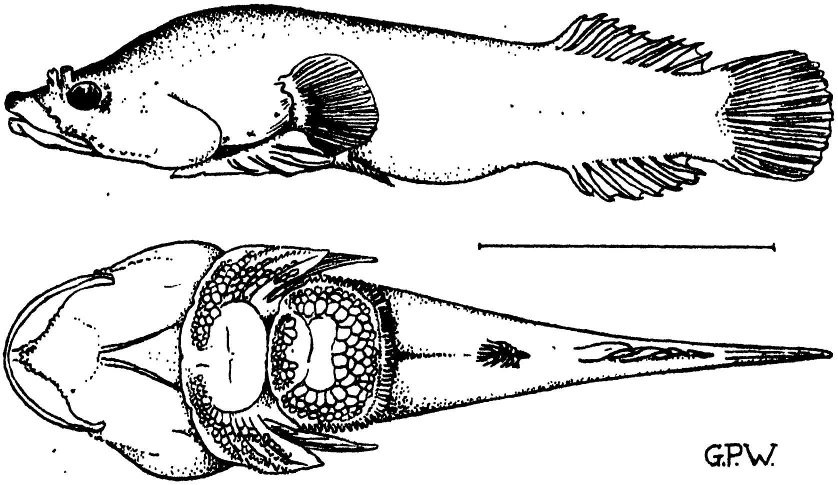
This species is here figured from a virtual topotype, 2 inches long, from Anse Vata, Noumea, New Caledonia (Dr. R. Catala); Austr. Mus. regd. no. IB.2319. It has D.15, A.14, V.4 and C.2 plus 15 plus 2. It appears to differ from *deversor* and *ornatus* as follows :—

A. 15 to 16 dorsal and more than 20 pectoral rays. Anal origin before that of dorsal. No mark on chin ... *lineatus*
AA. 12 dorsal and 18 pectoral rays. Anal and dorsal origins opposite. A dark mark below chin .... *ornatus*
AAA. 13 to 14 dorsal and more than 19 pectoral rays. Anal origin behind that of dorsal. No chin mark. Tail crescent-mark faint .... *deversor*

Family GOBIESOCIDAE.

Trachelochismus pinnulatus (Bloch & Schneider.)

(Figure 11.)



Clingfish, ***Trachelochismus pinnulatus*** (Bloch and Schneider).
Topotypical specimen from New Zealand. G.P.W. del.

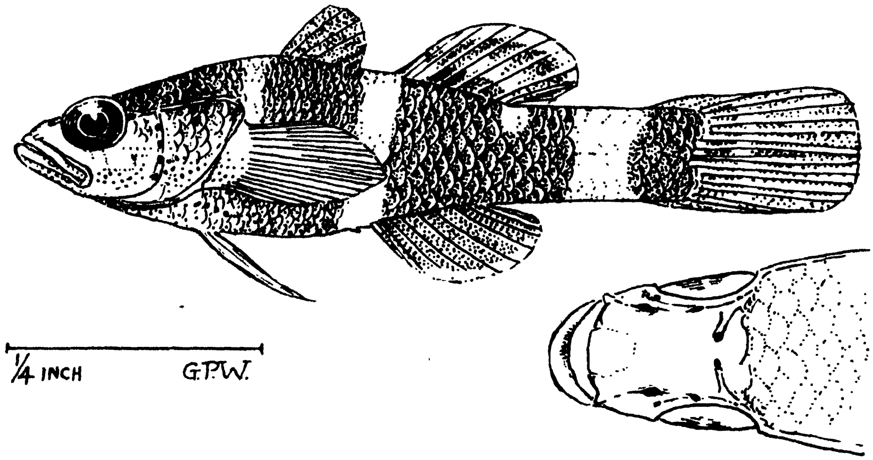
This New Zealand species is figured from a Queen Charlotte Sound topotype (Austr. Mus. regd. no. IB.2439), 70 mm. long, with D.9, A.7, V.4, C.10 plus short lateral rays.

Family ELEOTRIDAE.

Genus **Lindemanella** Whitley, 1935.

Lindemanella iota Whitley.

(Figure 12.)



Gudgeon, *Lindemanella iota* Whitley.
Holotype from Lindeman Island, Queensland. G.P.W. del.

Lindemanella iota Whitley, Rec. Austr. Mus., xix, 1935, p. 241. Lindeman Island, Queensland; freshwater. Holotype in Australian Museum. *Id.*, Koumans, Zool. Meded., xxii, 1940, p. 170.

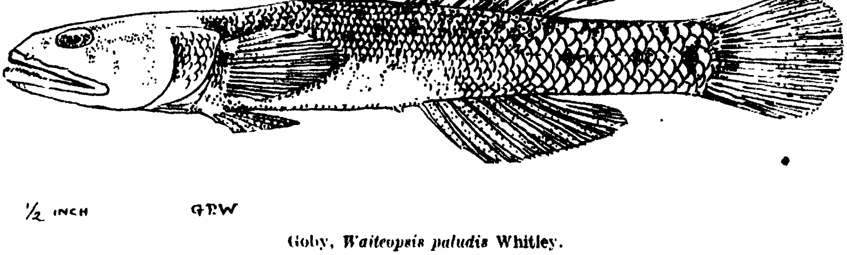
The holotype of this species is now figured for the first time. Koumans thought this might be the young of *Ophiocara aporos* (Bleeker) but the coloration (recalling that of *Brachygobius* spp.) is very different, scales do not extend far forward over the interorbital, and there are more than two preopercular pores on each side.

Family GOBIIDAE.

Genus **Waiteopsis** Whitley, 1930.

Waiteopsis paludis Whitley.

(Figure 13.)



Goby, *Waiteopsis paludis* Whitley.
Holotype from Port Hacking, New South Wales. G.P.W. del.

Waiteopsis paludis Whitley, Austr. Zool., vi, 1930, p. 122. Gundamaian, Port Hacking, N.S. Wales. Types in Australian Museum. *Id.*, Koumans, Prelim. Revis. Gobioid, 1931, p. 162. *Id.*, Whitley, Fish. N.S.W. (McCulloch), ed. 3, 1934, supplement. *Id.*, Koumans, Zool. Meded., xxii, 1940, p. 169. *Id.*, Ivey, Proc. Roy. Zool. Soc. N.S. Wales, 1949-50 (2 April, 1951), p. 55 (habits).

Ellogobius abascantus Whitley, Rec. Austr. Mus., xx, 1937, p. 17, figure 4. Bateman's Bay, N.S. Wales. Types in Australian Museum. *Id.*, Koumans, Zool. Meded., xxii, 1940, p. 171.

The holotype of *Waiteopsis paludis* is illustrated here; apparently *Ellogobius abascantus* is generically and specifically synonymous, the differences in scale-counts, extent of maxillary, and shape of dorsal fin, etc., evidently being due to growth and variation or sex.

Family ECHENEIDAE.

Echeneis squalipeta Daldorf.

Echeneis squalipeta Daldorf, Skr. nat. Selsk. (Copenhagen), ii, 2, 1793, p. 157.

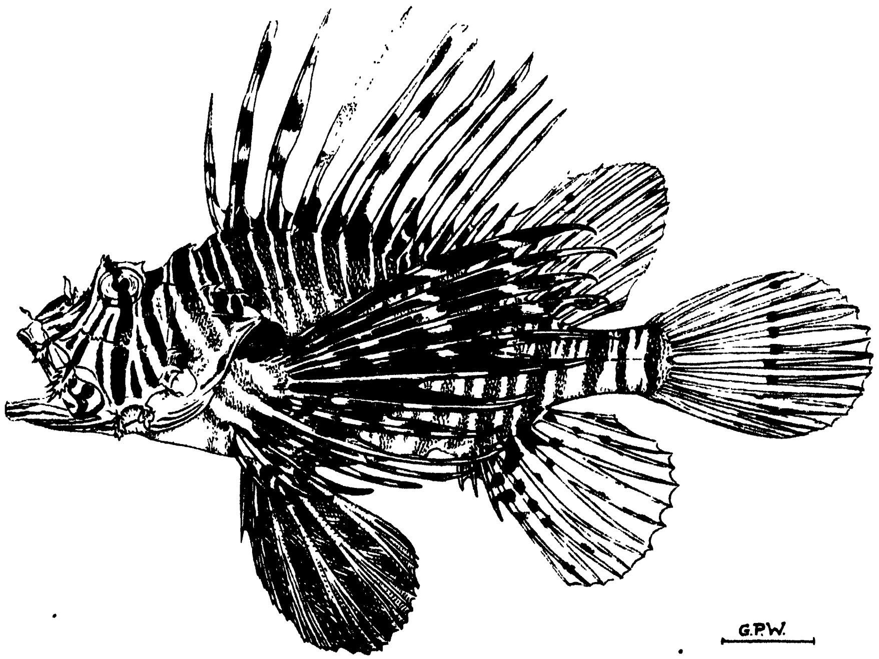
Add to synonymy the overlooked name : *Echeneis tropicus* Andrew Murray, Edinb. New Philos. Journ., (n.s.) iv., 1856, p. 287, figures 1-3, preoccupied by *E. tropica* Donndorff, Zool. Beytr., iii, 1798, p. 321, which is a *Phtheirichthys*.

Family SCORPAENIDAE.

Subfamily PTEROINAE.

Pterois volitans castus, subsp. nov.

(Figure 14.)



Butterfly Cod, *Pterois volitans castus* Whitley.
Holotype of subspecies from Port Hedland, Western Australia. G.P.W. del.

The Butterfly Cod *Pterois volitans* (Linné) is a very well-known fish but its geographical variations have been little studied. In The Australian Museum, Western Australian specimens are easily distinguishable from typical *volitans* by having few (2 to 13) spots on the tail fin instead of very numerous ones. This new subspecies has D, xii, i, 11; A. iii, 7; P.14; C.14 and general appearance as here figured from a specimen 180 mm. in standard length or 9½ inches overall, the largest of a series of six.

The development of supraorbital tentacles and the length of pectoral fins vary considerably, but the constantly plainer posterior fins indicate that a subspecies has developed in Western Australia. Most of the specimens are from Broome but one (with an abnormal left ventral fin of a spine and only three rays) came from the Abrolhos Islands; the figured specimen came from Port Hedland (holotype of subspecies; regd. no. I.12941). All the fourteen pectoral rays are simple and the nape and interorbital are scaly. Japanese specimens of *P. lunulatus* Temminck and Schlegel in The Australian Museum have much lighter ventral fins with dark spots, and have dark lunate marks on the pectorals.

Ranipterois, gen. nov.

Orthotype, *Brachypterois serrulifer* Fowler = *Ranipterois serrulifer.*

New name for *Brachypterois* Fowler (Proc. U.S. Nat. Mus., lxxxv, 1938, pp. 51 and 79) which is preoccupied by *Brachypterois* Jordan and Seale (Bull. U.S. Bur. Fish., xxv, 1905 (1906), p. 189) which Fowler (Mem. Bern. Bish. Mus., x, 1928, p. 67) made synonymous with *Bathypterois* Gunther.

NEW GENERIC NAMES.

The following generic names of fishes are preoccupied. References to literature will be found in Neave's "Nomenclator Zoologicus". The genotypes of the new genera are those of the ones they replace.

Todarus Grassi and Calandruccio, 1896 = *Nettodarus*, gen. nov. (Todaridae *olim* = Nettodaridae, nov.). Type, *Nettastoma brevirostre* Facciolà, 1887 = *Nettodarus brevirostris.*

Xiphostoma Spix, 1829 = *Spixostoma*, gen. nov. (Xiphostomatidae *olim* = Spixostomatidae nov.) Type, *S. cuvieri* (Spix).

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